# Petroleum Processing

INCLUDING PETROCHEMICAL SECTION OCTOBER, 1955

**FIRE! What Then?**

...the "Whiting" Story—p. 1559

ALSO IN THIS ISSUE


FUELS FOR GAS TURBOS—a problem facing refiners . . . . . p. 1553

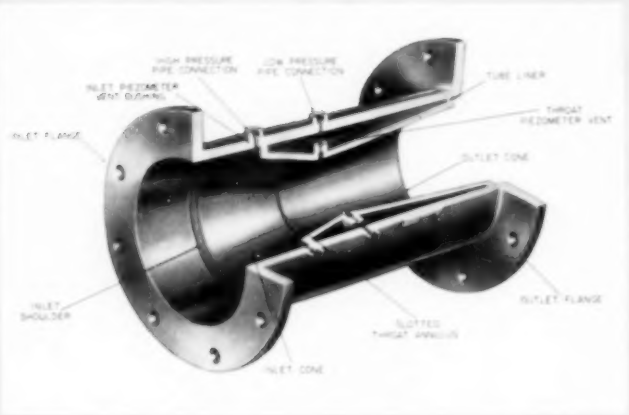
HOW IS YOUR AIR?—Tips on compressor accessories . . . . . p. 1578

WHERE TO BUILD?—A basic guide for plant location . . . . . p. 1587



A McGRAW-HILL PUBLICATION

# DON'T LOSE YOUR HEAD!




## IT CAN PROVE COSTLY!!!

### THE PROBLEM

Head loss can prove expensive. The natural gas industry finds this increasingly true as the booming market for this commodity makes the industry more "efficiency conscious". Modern conservation practices have become a must . . . and a definite trend toward replacing the conventional orifice plate with the Dall Flow Tube has started.

### THE SOLUTION

The Dall Flow Tube operates with the lowest head loss obtainable with any known velocity-increasing differential producer. This flow measuring device is unsurpassed for differential pressure recovery . . . with consequent savings in pumping and transmission costs. These advantages apply over a full range of throat-to-line-diameter ratios. Besides providing a maximum in power savings, additional savings can be realized at initial installations. A single Dall Flow Tube can replace several parallel large orifice runs requiring longer approach sections of straight pipe.

### Additional Features

★ *The discharge coefficient of the DFT is stable and constant over a wide flow range (for flows above a Reynolds number of 300,000). Complete range data are available on request.*

★ *"Enduring accuracy" is achieved since Dall Flow Tubes are self-scouring and of such rugged, durable construction that all critical dimensions and surfaces remain unchanged even after years of service. The size and weight of these units provide ease of installation.*

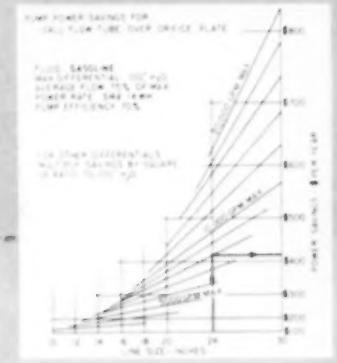
**"THE BEST COSTS LESS"**

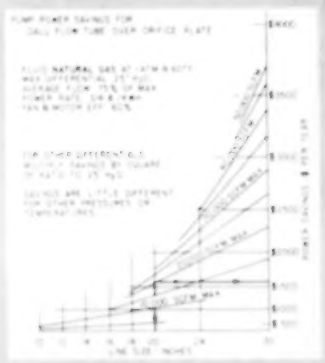
## TECHNICAL DATA

### PUMP POWER SAVINGS

Annual savings to users of Dall Flow Tubes may be approximated by referring to the charts below. Each is entered at the bottom at the appropriate line size and traced vertically to the intersection with the sloping flow line corresponding to the maximum capacity of the meter installation. The annual pumping power savings read along the vertical scale (right-hand side) opposite this intersection.

Although gasoline and natural gas are used in the examples, the order of yearly savings for other fluids is generally the same. Gases under other line conditions do not yield cost values markedly different from those shown.





Fabricated Dall Flow Tubes, which combine the advantages of the DFT profile and insert or flange mounting, are also available. The structure is a strong weldment of rolled plates and bar. All surfaces which are critical to the accurate prediction of flow characteristics are precisely machined to the Dall formula. This model offers design flexibility, low initial cost, and a wide choice of materials to suit application.

For complete details, write today for Bulletin 115-L1. Also ask for information on secondary instruments. Builders-Providence, Incorporated, 447 Harris Avenue, Providence 1, Rhode Island.

# BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

B-I-F METERS FEEDERS CONTROLS

# Don't throw in the sponge!

● We're the first to admit that it is no easy job to specify and buy the thousands of products needed to operate a modern refinery or petrochemical plant. But before you throw in the sponge and retire to that South Sea island, call "Oilwell."

We've been living with procurement problems such as yours for 92 years. Skilled specialists are available who spend all their time working with men like you. Completely stocked warehouses are strategically located so that you can get the item you want direct from our stocks—in a hurry.

Why not call "Oilwell" the next time you have a problem?

**Complete warehouse system**—Well stocked warehouses are conveniently located to serve the important refining centers. Inquiries are given prompt attention and deliveries are made quickly to meet your emergency requirements.

**Lower inventory investments**—You can cut your own warehouse stocks to a minimum, reduce obsolescence and get a wider selection of materials, sizes and brand names from "Oilwell's" complete inventories.

**Experienced personnel**—"Oilwell" refinery specialists, having been trained in refining and petrochemical plants, understand your material and service problems and can give you the service you require.

**Quality products**—"Oilwell" stocks include the best known brand names in equipment and materials designed and approved for refinery operations. When it comes from "Oilwell," you know it will meet your specifications.

**92 Years of experience**—From almost the beginning of the petroleum industry, "Oilwell" has worked with the men engaged in drilling and production. Our goal is to extend the same prompt, dependable and complete service to those responsible for Refining and Petrochemical operations.

## These famous products are sold by "Oilwell"

| | |
|---|---|
| Bridgeport Brass | Taylor-Forge |
| Catawissa | Thermoid |
| Johns-Manville | Vogt |
| Lunkenheimer | Walworth |
| Manning, Maxwell & Moore | Watson-Stillman |
| National Tube | Wilson-Snyder |
| | Worcester |

and many others

**OIL WELL SUPPLY**
DIVISION
UNITED STATES STEEL CORPORATION
Executive Offices—DALLAS, TEXAS
with Refinery Warehouses at

Beaumont, Texas · Garland, Texas · Houston, Texas
Borger, Texas · Los Angeles, California
Casper, Wyoming · Odessa, Texas
Charleston, W. Virginia · Ponca City, Oklahoma

USS

*Branches Serving All Oil Fields*

# "OILWELL"

TRADE MARK

UNITED STATES STEEL

# Reader's Guide What's New in Petroleum


## FIRE! What Then?

At 6:12 a.m., Saturday, August 27, a $10,000,000 fire struck the Whiting refinery of Standard Oil Co. (Indiana). Two days later, PETROLEUM PROCESSING's Editor William F. Bland was on that story. He spent several days and nights digging out the facts and learning the problems that had to be met and how to meet them.

**Bill's story should help** the entire petroleum processing industry. It will give information on how to do a better job: first in fire protection itself, and second, in fighting fire if protection fails.

**You can profit** by this story on Indiana Standard's experience, beginning on **page 1559**

**What Do You Do When Disaster Strikes Your Plant?**

## FIRE!

### Problems — and their Solution

What the company did when both communications and power supply failed, and when the scope of the fire area grew greater than anticipated **p. 1564**

I II III 3 5

## FIRE!

### Shutting the Plant Down

Of major importance during a disastrous fire is the job of getting the process units shut down safely. Here's what Indiana Standard had to do **p. 1566**

I II III 3 5

## FIRE!

### What Happened at Whiting

A factual round-up describing the Indiana Standard refinery and the damage that resulted when the new Orthoformer unit exploded. **p. 1560**

I II III 3 4 5

## FIRE!

### Getting the Plant Back Onstream

Seven steps for returning the plant to operation once the fire is out or under control, as developed and used at Whiting. **p. 1566**

I II III 3 5

## FIRE!

### The Orthoformer — and the Explosion

A description of the process unit itself, and a discussion of the possible theories advanced so far as to the cause of the explosion. **p. 1563**

I II III 2 3 4 5

## FIRE!

### Fire Protection — Men & Equipment

How Whiting is organized to fight fire and the kind of equipment it uses in maintaining one of the best fire safety records in the industry. **p. 1568**

I II III 3 5



A McGRAW-HILL PUBLICATION

ABP ABC

Member of Associated Business Publications and Audit Bureau of Circulations

**Petroleum Processing** is published monthly by McGraw-Hill Publishing Co., Inc., James H. McGraw (1860-1948) founder.

**Publication Office:** 330 West 42nd St., New York 36, N. Y.

**Executive, Editorial and Advertising Offices:** McGraw-Hill Building, 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Circulation Director.

Subscriptions: Address correspondence to Petroleum Processing, Subscription Service, 330 West 42nd St., New York 36, N. Y. Subscription rates: domestic single copies, 35c, U. S. and possessions, Canada, and all other countries, $2 per year, $3 for two years, $4 for three years. Orders must indicate company and position.

Published prior to Sept. 1946 as the Technical Section of National Petroleum News, devoted to Refinery Management and Petroleum Chemical Technology, and including International Petroleum Technology. Entered as second class matter March 12, 1954, at the Post Office in New York, New York, under the act of March 3, 1879. Printed in U.S.A.



Copyright 1955 by McGraw-Hill Publishing Co., Inc. All rights reserved.

# Processing for October, 1955


PETROLEUM REFINING I | PETROCHEMICAL MANUFACTURING II | GAS & LIQUIDS RECOVERY III | RESEARCH & DEVELOPMENT 1 | DESIGN & ENGINEERING 2 | PLANT OPERATION 3 | MAINTENANCE & CONSTRUCTION 4 | MANAGEMENT & PERSONNEL 5

**Turbos — a Refiners' Problem?**

What fuels and lubricants will the gas turbine engine require? This is a problem for the petroleum processing industry no matter when the turbo arrives, and it will differ to a certain extent depending on the use to which the turbo is put.

Here is must reading. It is a review of the answers to this problem as seen today by authorities in the various affected industrial fields – railroads, aircraft, automobiles, marine use, and refining itself. **p. 1553**

I 1 5

**Locating a Petrochemical Plant**

A basic guide developing four essential factors to keep in mind – type of product, cost of transporting the raw material, costs of shipping the product, and the size of the plant. **p. 1587**

II 3 5

**Primary Petrochemicals Up Again**

Output rose 19% from 1954 as compared to 1953, a slower gain rate than the preceding period. This is an analysis of the annual report on synthetic organic chemicals by the U.S. Tariff Commission. **p. 1592**

II 5

**A Report on "Iso-Plus"**

Good yield-octane relationships have resulted in both pilot plant and full-scale operation of Iso-Plus catalytic reforming via the thermal reforming route. By Heinz Heinemann, F. R. Walser, and J. B. Maerker. **p. 1570**

I II 1 3

**Six Instrumentation Problems**

. . . and their solutions, as used in as many different applications in petrochemical processing, and including such variables as flow and pressure under varying operating conditions. **p. 1594**

II 2 3

**Checked Your Air Supply Lately?**

For dependable compressed air, your system may need some additional accessories or maybe the ones you're using need replacement. R. A. Schaefer gives you tips on the proper accessories to use and what they can do. **p. 1578**

I II III 3 4

**Sorbic Acid; Nitroparaffins**

Are these new words to you? Well, they're new words to many of us. Keep posted on the definitions of petrochemical terms, this and every month in the regular "New Word" department, by B. H. Weil **p. 1597**

I II III 1 2 3 4 5


## DEPARTMENTS


| | | | |
|---|---|---|---|
| Publishers Page | 1511 | Personals | 1605 |
| What's Happening | 1513 | Patents | 1609 |
| Tomorrow | 1517 | Suppliers | 1613 |
| Letters | 1519 | Meetings | 1619 |
| Operating Trends | 1521 | Books | 1625 |
| News in Views | 1597 | Information Offered | 1626 |
| New Words | 1597 | Advertisers' Index | 1628 |
| Plant Practices | 1599 | What's New | 1629 |

Editorials 1660


**HOW TO USE IT:**

Your new "Reader's Guide to What's New in PETROLEUM PROCESSING" will do two things for you. First, the key numbers with each article will tell you at a glance if it is within your scope of interest; Roman Numerals indicate industries; Arabic Numerals, fields of activity. Second, the longer descriptions will tell you what each article is about, and why it can be of help and interest to you. —THE EDITORS

## To locate your friends

at the November **API Convention** in San Francisco

## Telephone McGraw-Hill Petroleum Publications'

Convention Registration **Information Center**

# GArfield 1-5841

- The Information Center operators will be able to tell you if the customer, prospect or friend you are looking for is registered and, if so, what hotel he is staying at and what his room number is. They also will be able to give you company-suite locations.
- Phone booths with direct lines to the Information Center will be located in the lobbies of the Sheraton Palace, St. Francis, Fairmont and Mark Hopkins.

*This service will be supplied courtesy of*

McGRAW-HILL
PETROLEUM PUBLICATIONS

| | |
|---|---|
| **Petroleum Week** | **National Petroleum News** |
| **Petroleum Processing** | **Platt's Oilgram News Service**<br>**Platt's Oilgram Price Services** |

# Davison M-S®

# HIGH ALUMINA Catalyst

## DAVISON GIVES YOU HIGH ALUMINA CATALYST IN THE PARTICLE SIZE BEST SUITED FOR YOUR UNIT!

**HIGH ALUMINA M-S CATALYST PARTICLE SIZE DISTRIBUTION**

*The catalyst with a minimum of fines . . .*

| Grade | F-3-25 Extra Fine | F-2-25 Fine | F-1-25 Inter-mediate | C-1-25 Coarse | C-2-25 Extra Coarse |
|---|---|---|---|---|---|
| Size range by C.A.E.; Wt. % | | | | | |
| 0-10 Microns | 4 | 2 | 1 | 1 | 1 |
| 0-20 Microns | 9 | 4 | 2 | 2 | 2 |
| 0-30 Microns | 16 | 11 | 6 | 5 | 4 |
| 0-40 Microns | 28 | 21 | 12 | 10 | 8 |
| *. . . and a minimum of coarse particles* | | | | | |
| Sieve analysis: Wt. % | | | | | |
| on 100 mesh (149 microns) | 0 | 0 | 1 | 1 | 1 |
| on 140 mesh (104 microns) | 1 | 1 | 4 | 6 | 8 |
| on 200 mesh (74 microns) | 4 | 5 | 15 | 22 | 33 |

Now Davison has taken the characteristics of High Alumina Catalyst and combined them with the proven advantages of its 13% Alumina Catalyst. This gives you, for the first time, High (25%) Alumina Catalyst with *all* these qualities:

- ***Lower Stock Losses***
- ***Better Maintenance of Activity and Surface Area***
- ***Narrow Particle Size Distribution***
- ***High Attrition Resistance***
- ***High Purity and Uniformity***

For information on Davison High Alumina Catalyst see your Davison Representative or write.

Progress Through Chemistry

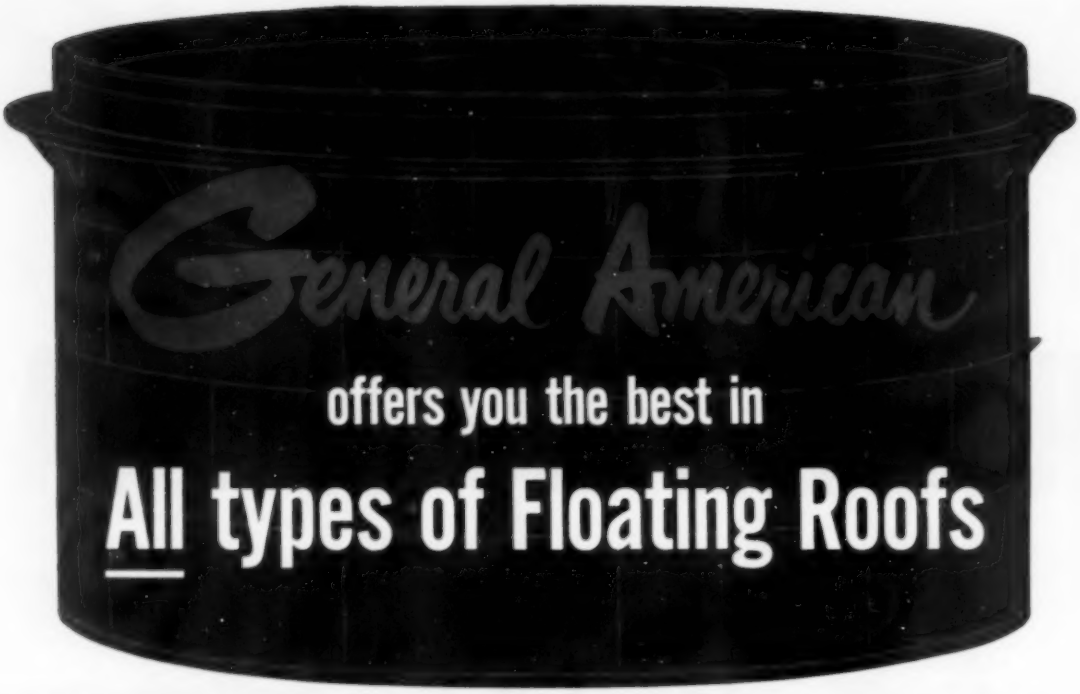
**DAVISON CHEMICAL COMPANY**

*Division of W. R. Grace & Co.*

**Baltimore 3, Maryland**

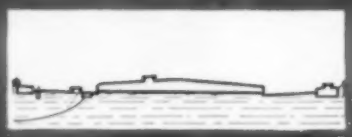
**Sales Offices: Chicago, Ill.; Houston, Tex.; New York, N. Y.; Baltimore, Md.**
**Davison Chemical Company, Ltd., Toronto 1, Ontario, Canada**

PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, TRIPLE SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS AND SILICOFLUORIDES. SOLE PRODUCERS OF DAVCO® GRANULATED FERTILIZERS.



**WIGGINS HIDEK***

This is the natural design for storage of volatile products. A variable volume of vapor trapped beneath the steeply-pitched, quick-draining deck adds to its efficiency.



**WIGGINS LODEK***

Designed so that the underside is in complete contact with the liquid surface. No vapor space can exist beneath the floating roof. Especially recommended where corrosive products are stored.

**WIGGINS DOUBLEDEK***

If you prefer a double-deck roof choose the best—the new Wiggins Doubledek. Complete drainage design and between-deck accessibility add up to unmatched efficiency and safety.

**WIGGINS FLOATING ROOFS PAY FOR THEMSELVES**

*Whatever your Floating Roof requirements get General American's UNBIASED analysis. Unbiased because General American makes ALL types of Floating Roofs!*

***Wiggins Floating Roofs, Dry Seal Gasholders, Lifter Roofs, Cone Roofs***

*patented

**GENERAL AMERICAN TRANSPORTATION CORPORATION**

135 South La Salle Street • Chicago 90, Illinois

**Petroleum Processing**

# Publisher's Page

A McGRAW-HILL PUBLICATION

Editorial & Business Offices
330 West 42nd St., New York 36, N.Y.

**Harry L. Waddell, Publisher**

**Editorial Staff**

William F. Bland, Editor
William C. Uhl, Managing Editor
Virgil B. Guthrie, Associate Editor
Robert L. Davidson, Assistant Editor
Willis A. Bussard, Assistant Editor
Alan Corneretto, Assistant Editor
William A. Caperell, Jr., Art Director
Stuart D. Boynton, Editorial Assistant
Grace McKay, Editorial Assistant
D. P. Thornton, Jr., Southwestern Editor
W724 Prudential Bldg., Houston 25
Richard R. Elwell, West Coast Editor
1111 Wilshire Blvd., Los Angeles 17
Andrew R. Patle, Washington Editor
1188 Nat'l. Press Bldg., Washington 4
Peter J. Gaylor, Patent Reviewer

**Business Staff**

K. W. McKinley, Advertising Sales Mgr.
R. H. Loyer, Business Mgr.
John E. Thompson, Production Mgr.
George Reid (Houston)
Assistant to the Publisher

**Regional Sales Representatives**

NEW YORK 36, N. Y.
Fred R. Emerson, 330 West 42nd St.
Walter W. Patten, 330 West 42nd St.
PHILADELPHIA 3, PA.
Fred R. Emerson, 17th and Sansom Sts.
ATLANTA 3, GA.
S. T. Henry, 801 Rhodes-Haverty Bldg.
CLEVELAND 15, OHIO
William R. Freeman, 1510 Hanna Bldg.
CHICAGO 11, ILL.
Robert W. Bruley, 520 N. Michigan Ave.
HOUSTON 25, TEXAS
J. H. Cash, W724 Prudential Bldg.
DALLAS 1, TEXAS
J. H. Cash, First Nat'l Bank Building
SAN FRANCISCO 4, CALIF.
T. Evans Wyckoff, 68 Post St.
LOS ANGELES 17, CALIF.
William C. Woolston, 1111 Wilshire Blvd.

## Meet Alan and Buzz

WE'VE been telling you recently on this page about our current program for expanding the editorial sections of PETROLEUM PROCESSING so as to give you more articles and special features and more data to help you in your job. This expansion has meant, naturally, a corresponding expansion in the staff itself—more people to do the things we want to do for you.

The first man to join us was new only to our own staff. Alan Corneretto, whose career as a PETROLEUM PROCESSING editor began August 8, in time for the last few licks at putting out the September issue, has been a McGraw-Hillite since 1949. He has been on the editorial staffs of *Construcción* and *Industria,* two Spanish language technical magazines for Latin American readers.

A native New Yorker, Alan attended Columbia University and put in an Army hitch, '44-46, eventually getting to Austria, before joining McGraw-Hill. In addition to a solid background of knowledge of all types of industrial and construction equipment, he has gained a skill with words and pictures which will soon be evident in the articles you read in PETROLEUM PROCESSING.

He is already at work on a number of projects which will help round out your files of information on the petroleum processing industry outside the borders of this country.

Our other new editor, Willis A. Bussard, joined us August 22, coming up to New York from Wilmington, Del., where he had been with Industrial Models for the past three years. Born in Montana, raised in Washington, and educated in California (Cal-Tech, mechanical engineer, '44), "Buzz" apparently never heard the usual advice of "Go West, Young Man!" He came East instead and joined Du Pont in 1946, with whom he stayed until 1952. He was primarily concerned with construction and startup of new processing units. Between Cal-Tech and Du Pont he squeezed in two years in the Navy on submarine duty.

Unlike Alan, who is still single, Buzz is married and the father of three children. The Bussards make their home in Princeton, N. J.

We're glad to have Alan and Buzz with us. And after they've had an opportunity to get out and meet some of you on their editorial assignments, we feel confident you too will be glad we have them with us.

William F. Bland

—Editor

**Other McGraw-Hill Petroleum Publications**

***National Petroleum News***
The monthly magazine of oil marketing—news, prices, transportation, storage merchandising

***Platt's Oilgram News Service***
A daily independent oil-news reporting service issued from New York, Chicago, Houston

***Platt's Oilgram Price Service***
A daily independent oil-price reporting service issued from New York, Chicago, Houston

***Petroleum Week***
The industry-wide magazine—covering production, processing, transportation, marketing

. . . as corrosive as hydrochloric acid

. . . as critical as caustic soda

. . . as volatile as chloroform

as viscous as molasses

**are stored safely in General American tank storage terminals**

Easy-to-handle liquids and problem liquids alike . . . they're all in a day's work for the men at General American terminals. Storage capacity of over half-a-billion gallons is available for any liquid that can flow through a pipeline.

Facilities are also available for blending to your specification . . . for drumming, barreling and canning to meet your needs. You get the privacy, service, safety and flexibility of your own terminals without capital investment.

By maintaining liquid inventories at General American terminals, you can fill rush orders for your customers or meet your own needs quickly, efficiently and economically.

***It Pays To Plan With General American***

**Terminals located at:**

*Port of New York (Carteret, N. J.)*
*Port of New Orleans (Good Hope, La.)*
*Chicago, Illinois (Bedford Park)*
*Port of Houston (Galena Park and Pasadena, Texas)*
*Corpus Christi, Texas*

GENERAL AMERICAN TANK STORAGE TERMINALS

a division of **GENERAL AMERICAN TRANSPORTATION CORPORATION**

135 South La Salle Street • Chicago 90, Illinois

# What's Happening

## *in Refining*

. . . **Socony Mobil Oil Co., Inc.,** has awarded A. G. McKee & Co. construction contract for new 9000 b/d Sovaformer at Buffalo, N.Y., with completion scheduled for May 1, 1956.

. . . **Imperial Oil Ltd.** has awarded Fluor Corp. of Canada Ltd. construction contract for a 13,500 b/d catalytic reformer for Sarnia, Ont., refinery with completion scheduled for Sept., 1956. New unit is main item in a $5,000,000 expansion program at the Sarnia plant.

. . . **Union Oil Co. of Calif.** has begun construction of asphalt air-blowing units at Edmonds, Wash., refinery. Capacity of the $400,000 facilities will be 100 ton/day.

. . . **The Texas Co.** has started project to boost alkylation capacity at Lockport, Ill., from 3200 to 4400 b/d of alkylate yield, with completion expected by April, 1956.

. . . **Continental Oil Co.** is adding a 1500 b/d catalytic reformer to its Artesia, N. Mex., refinery at an estimated cost of $500,000. Completion is scheduled for Jan., 1956.

. . . **Midland Cooperatives, Inc.,** is spending $750,000 on its 12,000 b/d refinery at Cushing, Okla., of which $600,000 is for a new Platformer.

. . . **Cosden Petroleum Corp.** expects completion of a 3868 b/d Rexforming unit late next spring. Company is also building a 1600 b/d Unifiner which will be onstream shortly.

. . . **Standard Oil Co. (Indiana)** has made no change in plans for construction of new Ultraformer unit at Whiting, where recently completed Orthoformer was destroyed in disastrous fire. (see pp. 1559-1569, this issue.)

. . . **Standard Oil Co. (Indiana)** was hit by a second fire two weeks after the Aug. 27 disaster struck at Whiting, Ind. A filtering plant was damaged to the extent of an estimated $50,000 to $100,000.

## *in Petrochemicals*

. . . **Aetna Oil Co.,** subsidiary of Ashland Oil & Refining Co., plans to convert its 11,000 b/d plant at Louisville, Ky., to the manufacture of petrochemicals at a cost of "several million dollars." Types of products were not revealed. Refining activities will be transferred to Catlettsburg, Ky.

. . . **Texas Butadiene & Chemical Corp.** has awarded Fluor Corp. engineering and construction contract for its $21,000,000 alkylate and butadiene plant near Houston, with completion scheduled for late in 1956 or early 1957.

. . . **Union Oil Co. of Calif.** will build a second sulfur recovery unit at Santa Maria refinery. Bechtel Corp. has contract for the $750,000 project, which will have capacity of 40 to 45 ton/day.

. . . **Phillips Chemical Co.** has started 15% expansion of its GR-S copolymer plant near Borger, Texas, with completion planned for Sept., 1956, at which time capacity will be approximately 72,500 long ton/year.

. . . **Standard Oil Co. of Calif's** 50,000,000 lb/yr. isophthalic unit, being built by H. K. Ferguson Co. at a cost of over $7,000,000 at Richmond, is slated for completion by end of this year.

. . . **Carbide & Carbon Chemicals Co.** will have doubled production facilities for vinyl acetate at Texas City by fall of 1956 as result of a multi-million dollar expansion project now underway.

. . . **Goodyear Tire & Rubber Co.** will boost capacity of its Houston synthetic rubber plant by 50%, from 137,500 to about 170,000 ton/yr., making it the largest unit of its type in the world. Bids for construction work and equipment will be sought soon.

. . . **Goodrich-Gulf Chemicals, Inc.,** is considering expansion of the Port Neches, Texas, plant purchased from the government last spring. Company announced recently the successful development in pilot plant stage of making a synthetic "natural" rubber, having reproduced the true molecule of crude, tree-grown rubber.

. . . **Gulf Oil Corp.** is giving serious consideration to still further expansion in ethylene capacity at Port Arthur, Texas. Decision is expected soon on plan for a third new unit similar in size to the second, a 220,000,000 lb/yr facility which went into operation recently.

. . . **Dow Chemical Co.** has started building another plant for manufacture of "Styrofoam," an expended, multicellular form of polystyrene, at Torrance, Cal., with completion scheduled for about Jan., 1956.

. . . **Southern Nitrogen Co., Inc.,** a new company, will start construction this fall of a $14,000,000 natural gas-to-ammonia plant, 250 ton/day capacity, at Savannah, Ga., with completion expected before the end of 1956. Said to be first synthetic nitrogen products plant in south Atlantic States, the facility will manufacture nitric acid, urea, nitrogen solutions, and

fertilizer grade ammonium nitrate, operating on gas supplied by Southern Natural Gas Co. of Birmingham, Ala.

## in Foreign Operations

. . . **The Iraq Government** has awarded contract to Foster Wheeler Ltd. of England for design and construction of a complete lube oil plant of 25,000 ton/yr capacity. Process units will include vacuum still, propane deasphalting, furfural refining, propane dewaxing, clay percolation, and acid treat.

. . . **Indian Government** is considering proposals for three more oil refineries. One is being investigated by Standard Vacuum Oil Co., a 100,000 b/d plant near Calcutta. The second is a $40,000,000 refinery in Saurashta of about 30,000 b/d capacity; and third of undisclosed size may be built in Assam, although it is also possible the existing Digboi plant there would be expanded.

. . . **A second oil-from-coal plant** in Union of South Africa, similar in size to existing unit at Sasolberg, is in the cards, according to E. Jansen, governor general.

. . . **British Petroleum Co.** will start construction near end of this year of 8000 b/d hydrofiner at Kent refinery in England and 5250 b/d hydrofiner at Hamburg, Germany.

. . . **Esso A.G.,** the west German subsidiary of Standard Oil Co. (N.J.) plans a refinery at Cologne with capacity of about 55,000 b/d. Construction will start next spring.

. . . **Chances for a new 4,000 b/d refinery** to be built in Costa Rica have become slim. Costa Rican legislature is said to be against proposal by an unidentified U.S. company for approval to build the refinery, to use duty-free imported crude oil. Refinery, which would have been first in Central America, was estimated to cost $3,500,000.

## in Transition

. . . **Commercial scale oil-from-tar sands** appeared closer to reality with announcement that Canadian government had sold its experimental extraction pilot plant at Edmonton, Alta., to Can America Oil Sands Development Ltd. of Calgary, a partner in an oil sands development program with Royalite Oil Co. Ltd.

. . . **U.S. Navy is enthusiastic** about its recently developed "dry" lubricant, polytetrafluoroethylene, said to have use also as a corrosion preventive in temperatures ranging from —75 to +500° F.

. . . **Canadian Oil Cos. Ltd.,** will become a fully integrated oil firm on completion of its purchase of Anglo-Canadian Oil Co. Ltd. The transaction covers some 13,000,000 bbl. of oil reserves in western Canadian provinces.

. . . **Continental Oil Co.** plans to stop running crude at its 3400 b/d refinery at Glenrock, Wyo., "within the next six to eight months." Plant may be sold, dismantled, converted to other operations, or something else may develop, according to firm.

. . . **Leonard Refineries, Inc.,** will take over the assets of Mid-West Refineries, Inc., and Roosevelt Oil and Refining Corp., by agreement among presidents of the three companies, but subject to approval by stockholders at meetings scheduled for Sept. 30 and later this month. Combined refining capacity of resulting company would be about 28,000 b/d.

## in Markets and Prices

. . . **Unusual firmness marked primary supply** markets in the transition from the big gasoline consuming season to the heating oil season this year. Refinery strikes and fires contributed much to this situation.

Idled by fire was Indiana Standard's 200,000 b/d refinery at Whiting, Ind. Refinery production lost by work stoppages included Republic Oil Refining Co. at Texas City, Texas (41,000 b/d), Pennzoil Co. at Oil City, Pa. (12,000 b/d), and Elk Refining Co. at Falling Rock, W. Va. (4,500 b/d).

That's not a whole lot compared with the nation's total refining capacity. But the shutdown plants meant added—and unanticipated—buying power hanging over the market in the summer to fall period.

. . . **August price increases in residual fuels** along the Atlantic Coast brought a slowing in demand for these oils in September—some utilities and other large consumer accounts converted from oil to coal.

. . . **Most pleasing to refiners** was the post Labor Day position of gasoline. Come the end of the "tourist season" in past years, and offerings of motor fuels would usually begin to slow up in volume. Not so this year. Refiners at the Gulf for the most part were sold up through September. And purchases and loans to replace losses caused by downtime at the Whiting plant of Indiana Standard kept the mid-Continent and Midwest markets devoid of soft spots.

. . . **Volatile products were the best performers** pricewise in September. Natural gasoline was up 0.5¢ per gal. to 5.5¢, Group 3, for Grade 26-70. And there was a general 0.5¢/gal increase in LPG prices. Group 3 price for propane reached 3¢.

. . . **Lube oil was tough.** With the Pennzoil and Elk plants out of the running, the spot buyer couldn't beg or borrow lubricating oils from other Pennsylvania refiners. Quotations—described as "largely nominal" —were up another 0.5¢/gal, to 18.5¢ for 200-vis neutral and 18¢ for bright stock.

# Lummus Coker for Yorktown Refinery Will Handle Heaviest Charge on Record

The Delayed Coking Unit for the new Yorktown, Virginia refinery of The American Oil Company will handle the heaviest feed ever charged to a Delayed Coker. The Lummus Company has been selected to design and construct the unit. Special techniques have been developed in Lummus laboratories and pilot plants to handle such heavy stocks.

Charge to the Unit will be vacuum reduced crude which will have 25.0% Conradson Carbon and an API gravity of 6.1°. SFS at 210° F is 6000. The products will be gas oil, gasoline, gas and C4's, plus 600 tons per day of coke. The Unit is also designed to handle lighter stocks at a maximum capacity of 9,660 B/D.

The Coking Unit will have four coke drums. The Lummus Heater, which is the heart of this process, incorporates the critical design factors to meet the wide range of charge stocks and throughputs.

The new coker will come on-stream late in 1956. As an integrated part of the Yorktown Refinery, it will help supply motorists' demand for more of the American Oil Company's premium unleaded motor fuel, "Amoco-Gas," marketed in 18 states from Maine to Florida.

Lummus has designed, engineered and constructed a large percentage of this country's modern coking capacity. Lummus can build a coker . . . or a complete refinery . . . for you. Let Lummus engineers show you how 50 years experience with over 700 major installations will produce maximum return on your capital investment.

The Lummus Company, 385 Madison Avenue, New York 17, New York. *Engineering and Sales Offices:* New York, Houston, Montreal, London, Paris, The Hague, Bombay. *Sales Offices:* Chicago, Caracas. *Heat Exchanger Plant:* Honesdale, Pa. *Fabricated Piping Plant:* East Chicago, Ind.

AMOCO

# LUMMUS

DESIGNING ENGINEERS AND CONSTRUCTORS
FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

# Grandma **likes** wax... Motors **don't**

**GB** ***builds de-waxers to fit your exact process requirements . . . tops in efficiency and long, dependable service.***

De-waxing and de-oiling rotary drum vacuum filters designed and engineered by Goslin-Birmingham have been recognized for many years as the standard for the industry. A continuous program of advancement and improvement in design, coupled with a reputation for exacting workmanship, has made G-B filters the reliable choice of leading refineries everywhere.

The newest design G-B MEK filters are 12′-0″ x 18′-8″ and provide 700 square feet of filtering area. Units are available with bearings supported on the vat, with a much stronger vat and supporting feet. Propane de-waxing filters range up to 400 square feet filtering area.

***For more complete information . . .*** *including recent test data from many foreign refineries . . . please write our Filter Engineering Department. There is no obligation.*

Installing the filter drum in a propane de-waxing filter. The bearings are inside the vat and involve a very unique method of holding the wear plate against the valve.

**GB**

**GOSLIN-BIRMINGHAM MANUFACTURING CO., INC.**

**BIRMINGHAM • ALABAMA**

## Future Brightens for Fluid Coke As a Useful Industrial Fuel

ESSO's new fluid coking process appears to offer some interesting possibilities for the reduction of residual fuel oil yields. In comparison with earlier coking processes, the fluid process is said to produce about twice the yield of gas oil (for subsequent cracking to gasoline) and only about half the yield of coke.

But as with all coking operations, the big problem that still remains is the disposal of the resulting by-product coke—the development of suitable markets that can utilize this material.

The problem is particularly intriguing with the fluid process because of the character of the coke. It is an essentially new industrial material, in the form of a dry, hard granular solid having roughly the particle size of coarse sand. It is composed of approximately 90% carbon, with other constituents varying according to the source of the crude.

**The ultimate basic use for this coke,** it now appears, may well be as an industrial fuel. Test work completed recently by Kaiser Engineers, Oakland, Calif., has shown the practicability of such use. Specifically, the company has reported on a series of full scale combustion tests conducted in a rotary kiln at the Permanente, Calif., plant of the Permanente Cement Co., in which fluid coke was successfully substituted for the usual natural gas used to fire the kilns.

The fluid coke was fed to the kiln from an elevated bin, flowing through a hopper bottom that connected directly to a 6-in. screw conveyor pipe. Coke discharging from the conveyor was aspirated by compressed air through a special burner into the kiln, using an existing 4-in. diameter oil burner housing.

**During a preliminary set of test runs,** the coke was fed to the burner as received from the refinery—with no attempt made to screen out larger pieces or to grind them to a smaller size. As a result, a fall-out of large particles of unburned coke was observed. These were later found in analyzed test clinkers, and it was decided to grind the coke for subsequent testing. Screen analyses before and after grinding are given below:

| Screen Size | Accumulated % Retained Before Grinding | After Grinding |
|---|---|---|
| 8 | 5.2 | —— |
| 16 | —— | 0.0 |
| 35 | 11.1 | —— |
| 50 | —— | 1.0 |
| 65 | 48.6 | 11.0 |
| 80 | —— | 20.1 |
| 100 | 80.1 | 50.3 |
| 200 | 95.8 | 75.5 |

Kaiser reports that this grinding can be done for less than 30¢/ton on a commercial basis and using methods developed by the company.

**In subsequent tests with the ground coke,** and using 50% natural gas as auxiliary fuel, the color, shape of the flame, lack of fall-out, and ignition 10 ft. beyond the nozzle indicated a performance almost identical with 100% gas flame. Maximum coke firing rate achieved with the equipment as set up was 6.75 tons/hr., which still required about 17% of the normal gas flow to maintain the kiln temperature—2,900° F. in the combustion zone. For several intervals of short duration, however, the gas was turned off and the kiln operated entirely on coke.

**Sampling and testing of the kiln effluent** was given particular attention during the tests, with reference to the sulfur content and the possibility of air pollution. From the test data and observations, Kaiser reports that the total sulfur released to the atmosphere with the entire plant (five kilns) operating 100% on coke "would probably be on the safe side, or not objectionable." This statement assumed that 50% of the effluent sulfur would be retained in the dust collected by the plants' precipitators, and was based on coke with a 6% sulfur analysis.

If the Kaiser tests are indicative of what can be done with fluid coke, it may well be that an entirely new market can be developed for this usually unwanted petroleum by-product. —W.F.B.

## Long-Range Research May Suffer From the Shortage of Scientists

PETROLEUM has been ranked third among major industries, in the degree of impact on its research activities caused by the shortage of scientists and engineers.

A report prepared for the National Science Foundation by the Bureau of Labor Statistics of the U. S. Department of Labor bases this conclusion on interviews with officials of some 200 large companies, of which 14 are oil concerns.[1]

**By definition, the study covers** only professionally trained men engaged in industrial research. It excludes men in research in scientific schools and in that carried on by the government, as well as scientists in research activities outside regular company laboratories. In view of this small segment of the field, some of the generalizations in the Science Foundation's report are broader than seem warranted.

"Industries where the proportion of companies reporting shortages of research scientists and engineers were largest were aircraft, electrical equipment, petroleum, paper, food and primary metal," the report states." . . . the survey of findings clearly indicates that, on a nationwide basis, the supply of qualified personnel is insufficient to meet the demand for research and development scientists in many fields."

**In discussing types of personnel needed,** the report brings out that the engineering fields in which sizeable numbers of companies reported shortages included chemical, electrical (especially electronic), mechanical, and aeronautical engineering.

Chemical engineers are needed by companies in the chemical and petroleum industries, the largest industrial employers of engineers in this category. A particular need was indicated for chemical engineers

with one to five years of industrial experience. However, there was also noted an extensive demand for new graduates in this field. The demand for chemists comes mainly from companies in the chemical, petroleum, and food industries.

**Oil companies generally agree** with the basic conclusion of the Science Foundation report that a shortage of scientists and engineers does exist. They add that it is most acute in those companies whose research programs have been widely expanded during recent years.

**The chief impact of the shortage** to date, according to oil companies, is that some of their long range fundamental research studies have had to be laid aside, temporarily at least. The pressure of industrial competition is forcing companies to give priority in manpower to the projects which are closer to the stage of commercial development. The full effect of this dropping of basic research will not be felt for some years, when technological progress in refining may bring greater need for new basic data.

The American Petroleum Institute program of fundamental research is filling in part of the gap caused by the oil companies having to shelve some of their individual basic studies. Several API projects are providing data which is useful to the refiners, and it is available to all companies in the form of numerous reports and more will be forthcoming.

The wider use of the data from the selected API projects can help to carry the refining industry through the period of the shortage of scientifically trained manpower, and can in part make up for the inability of some individual companies to carry on this type of work.

**A somewhat brighter spot** in the more distant future is the growing college population. By the early 1960's college graduation rolls will swell as a result of the war-time birth rate boom of the mid-1940's. If a good percentage of these upcoming youngsters can be persuaded to follow engineering careers, the shortage may begin to melt. —V.B.G.

(1) "Shortages of Scientists and Engineers in Industrial Research," prepared for the National Science Foundation by the U. S. Department of Labor, Bureau of Labor Statistics.

## Automobile Diesel Still Far Away Though New Engine Intriguing

SPECULATIVE interest in the wider use of Diesel engines in automotive vehicles has been heightened by the announcement in this country of a new German engine with a radical and perhaps revolutionary combustion system.(1) It is made by the Maschinenfabrik Augsburg Nurnberg works, in Nurnberg.

The "MAN" engine, dubbed "Whisper" here because of its quiet operation, is said to operate on any fuel from gasoline to jet fuels to Diesel fuel without sacrifice in engine performance. Two Diesel manufacturers in the U. S. have tested the German innovation and state it comes up to all claims of the manufacturers.

**Difference from conventional design** is in that the piston is designed with a combustion chamber in the center forming a little more than half a sphere. The throat of the chamber has a recess through which the fuel jets reach the wall of the combustion chamber at an acute angle. A vigorous air swirl sweeps the piston cavity as the piston approaches top center on the compression stroke. The principal part of the fuel is applied to the wall of the semi-spherical combustion chamber and becomes vaporized at a controlled rate. The wall temperature of the combustion chamber is cooled by oil sprayed from below.

**Three advantages were reported:**

"1—Deposit of the fuel on the combustion chamber wall in the form of a film, with a small amount of fuel being separated or distribution in the air and initial autoignition.

"2—Direction of the fuel jets tangentially to the direction of the air, so that the undesirable mixture of liquid fuel with the hot air is reduced to a minimum.

"3—Vaporization in the presence of very little air at low temperature, and gradual pre-oxidation as well as rapid mixture of the fuel vaporizing per unit time and a properly timed external ignition."

Belief that present commercial Diesel fuels are not all they should be started Dr. J. S. Meurer, German Diesel expert who invented the MAN engine, on his studies of reaction kinetics in fuel combustion.

He thinks refiners have been remiss in not improving their Diesel fuels to the same degree they have bettered motor gasolines. "It is a task for the future to change the molecular structure of the fuel so as to prevent the occurrence of undesirable chain reactions during combustion," Dr. Meurer told an audience of the Society of Automotive Engineers.(2)

The key to the smoke problem lies in the temperature history of the fuel prior to burning.

"Since gas molecules are more temperature stable than liquid molecules," he said, "smoke will be reduced if the hydrocarbons are completely vaporized before burning is initiated. If this can be accomplished there will be less smoke. Such a course also reconciles the contradictory requirements of a high cetane rating for ignition and a low one for burning, because the vapors of a Diesel fuel have a much higher cetane number than the liquid."

Automotive engineers with the oil companies look for continuing improvement in the high speed Diesel engine field. They also recognize that, when gasoline engine compression ratios reach 12:1, they will approach those in the Diesel engine range. However, they do not look for a switch to Diesels for general passenger car use to secure the inherent advantages of high compression. Weight and exhaust odors are still handicaps. An economic hurdle also would be providing nation-wide distribution of a uniform fuel for a new type of passenger car engine. —V.B.G.

(1) "Elevation of Reaction Kinetics Eliminates Diesel Knock—the M Combustion System of MAN," by J. S. Meurer, Maschinenfabrik Augsburg Nurnberg, Nurnberg, Germany; Society of Automotive Engineers Meeting, Atlantic City, June 12-17, 1955.
(2) Comment by Dr. Meurer following the discussion on his paper.

# Letters

## Correction, Please

To THE EDITOR: Will you please call to the attention of your readers the following errors which appear in the article entitled "Try the Gradiation Heater for Economic Ethylene Production," (August, pp. 1211-1215).

Fig. 5 on p. 1213: The phrase "Burner Pattern B — Bottom Row off" should read "Burner Pattern C — Top Row off."

Fig. 6 on p. 1214: In the series of curves "Ethane or Propane Conversion vs. Tube Pass from Outlet," tests 1 and 2 in the ethane group should be reversed in order.

ERNEST S. KOPECKI
Manager, Public Relations
and Promotion
Selas Corp. of America
Philadelphia, Penna.

• *Reader Kopecki added that he hoped this would clear the air. It seems both the contributors and ourselves had a field day with errors. We try hard to avoid them and succeed almost all the time. When we do pull a boner, it's a "beaut."*

## Koa Says Not So

To THE EDITOR: I wish to call your attention to a serious misstatement of fact in the article "Japanese Refining Booms" (August, pp. 1139-1142).

In the table on "Ownership of Nine Major Japanese Oil Companies" on p. 1141, you refer to the "other 50% (of Koa) owned by Nippon Oil Co." This is incorrect, as the other 50% is owned by Japanese shareholders, and not by Nippon Oil Co.

E. NOGUCHI
President and Director
Koa Oil Co., Ltd.
Tokyo, Japan

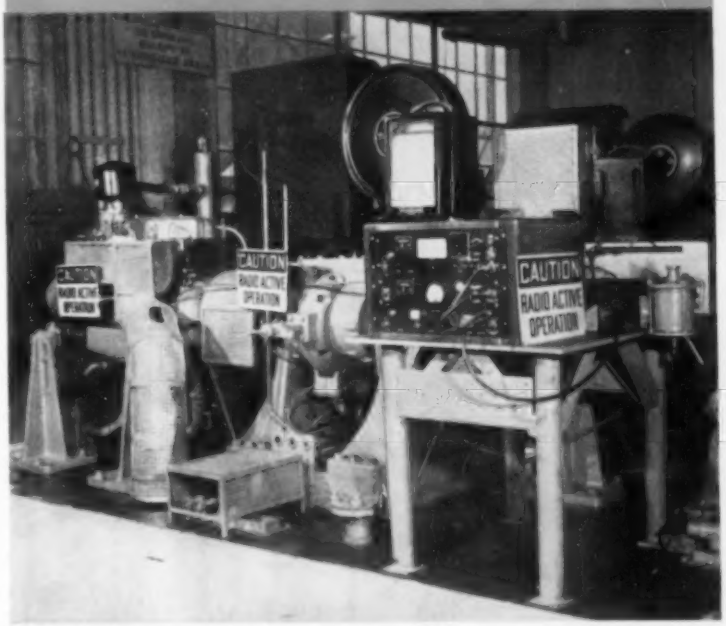
• *Apologies are in order for any inconvenience this may have caused Mr. Noguchi and his associates. The error was due to a misplaced asterisk which should have appeared on the listing for Nippon Petroleum Refining Co., 50% of which is owned by Nippon Oil Co.*

## Brickbats, We Love 'em

To THE READERS: Yes, we prefer criticisms and letters like the ones above which point out the errors of our ways. They help keep us on our toes. So keep them coming. Of course, we are like anyone else: letters of praise make us feel good, too. But do write them both, please.

THE EDITORS


**Better oil performance at a competitive treating cost with Oronite Lube Oil Additives**




Using the latest research techniques and test methods, such as determination of engine wear by use of radio-active tracers, (shown above), Oronite has developed a complete line of lubricating oil additives for all types of oil service.

Throughout the nation, marketers of Oronite additive compounded motor oils are gaining better sales positions with superior finished products they market. Better performance from Oronite additive compounded oils is due in part to Oronite's "custom-formulating" program of providing additives that meet the specifications of the individual oil marketer. And because of Oronite's years-ahead research, testing and manufacturing facilities, custom-compounding has been accomplished at progressively lower treating costs.

Why not talk over your problem with an Oronite additive specialist. Contact the Oronite office nearest you.

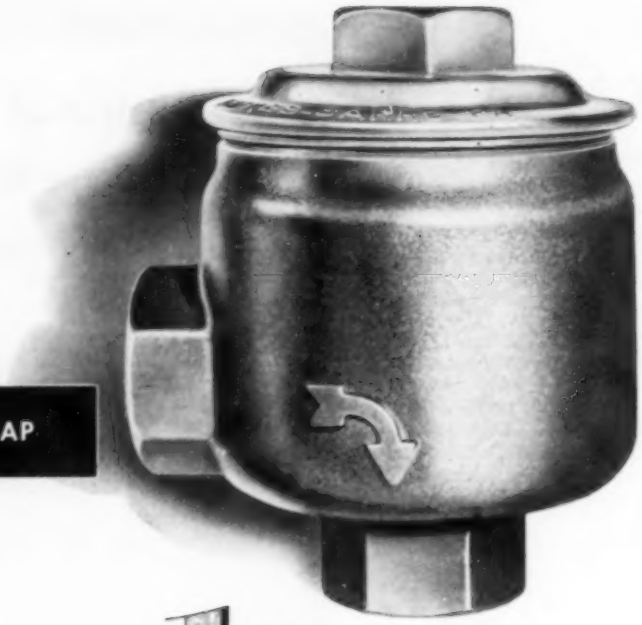
With Oronite Additives you can formulate oils to meet the new A.P.I. Service Classifications and can meet specifications for MIL-L-2104A, MIL-L-9000, Supplement 1 and Series 2 oils.

PARTIAL LIST OF OTHER ORONITE PRODUCTS
Gas Odorants
Polybutenes
Phenol
Wetting Agents
Fuel Oil Additives

ORONITE CHEMICAL COMPANY
200 Bush Street, San Francisco 20, California
30 Rockefeller Plaza, New York 20, New York
30 North Wacker Drive, Chicago 6, Illinois
714 W. Olympic Blvd., Los Angeles 15, California
Mercantile Securities Building, Dallas 1, Texas
Carew Tower, Cincinnati 2, Ohio

ORONITE CHEMICAL COMPANY

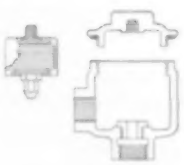

 (To obtain more data on advertised products see page 1628) 



STEAM TRAP

# Quality

Just 3 quality parts—thermostatic bellows, body, cap. Simple, positive action. Won't leak!



Nicholson quality . . . that gives you the extra strength, extra capacity, extra *stamina* required for severest petroleum processing service. Nicholson quality pays off, when it comes to discharging condensate and air from steam lines . . . most efficiently, dependably, economically.

- **Powerful valve action—big husky bellows.**
- **Positive shut-off—finely ground valve and seat.**
- **High capacity—large diameter orifice.**
- **Rigidly tested—on actual steam lines.**

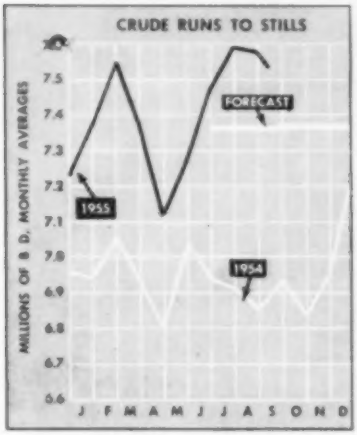
When less than best won't do, specify Nicholson. Send for *Catalog 953*.

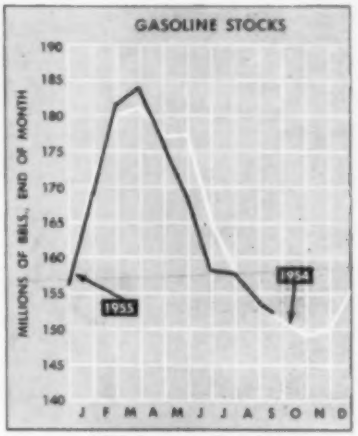
NICHOLSON

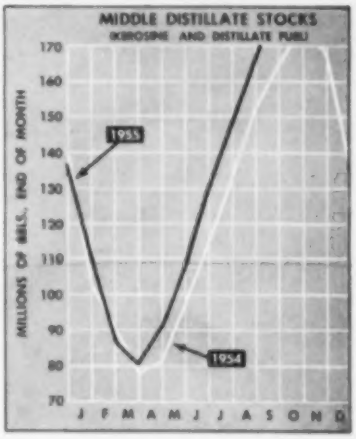
W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 58 PRINCIPAL CITIES




1955 figures to Sept. 16

# Distillate Demand to be 9% Larger

THE coming demand for distillate fuel oil will likely be 9-10% larger than a year ago, if we have a normal winter. Shipments from refineries will average over 2,218,000 b/d for the period Oct. 1, 1955-March 31, 1956, when over 70% of demand is for oil for heating.

To meet this peak demand for the heating season, refiners' stocks of distillate fuel oil are larger than last fall, both in volume and in terms of days' supply. Also, output of this product has been running around 14% larger than a year ago.

Distribution of distillate fuel oil stocks is in balance in the various refining districts. For the U. S. these inventories Sept. 16 (141,229,000 bbls.) were around 17,000,000 bbls. (13.8%) larger than on Sept. 17, 1954. They were nearly 64 days' supply of forecast demand for the period Oct. 1, 1955-March 31, 1956, while a year ago they were 61 days' supply of actual demand.

**OUTLOOK: Low point on refinery gasoline stocks this fall will be well above 150,000,000 bbls., unless runs are reduced.**

In the combined East and Gulf Coast districts, inventories Sept. 16 (72,979,000 bbls.) were 9,200,000 bbls. (14.5%) larger than Sept. 17, 1954. They were 60 days' supply of coming demand. Last fall they were 57 days' supply.

In the combined Ind.-Ill.-Ky. and Okla.-Kans.-Mo. districts, serving the middle west oil heating territory, combined distillate fuel oil stocks Sept. 17 (42,768,000 bbls.) were 4,840,000 bbls. (12.8%) larger than last fall. Current inventories are 70 days' supply of coming demand. Last year they were about 67 days. Refinery output of this product in these districts has been 15% higher than a year ago.

Gasoline stocks are leveling off after the normal seasonal decline earlier than last year, and the low point may be over 150,000,000 bbls. unless runs to stills are cut substantially.

Heavy movement of residual fuel oil stocks from California has reduced inventories there to 15,790,000 bbls. in mid-September, compared with 28,505,000 bbls. a year ago. This brought total U. S. stocks Sept. 17 to 46,700,000 bbls. (18%) lower than a year ago.

## SEPTEMBER KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbls. at end of month)

| | Sept. 1955* | Aug. 1955 | Sept. 1954 |
|---|---|---|---|
| **CRUDE OIL** | | | |
| U. S. Production | 6.669 | 6.666 | 6.151 |
| Imports | .779 | .744 | .672 |
| U. S. Stocks | 255.463 | 259.419 | 274.608 |
| Runs to Stills | 7.529 | 7.579 | 6.949 |
| **GASOLINE** | | | |
| Refinery Output | 3.726 | 3.778 | 3.420 |
| Refinery Demand | 3.922 | 3.985 | 3.586 |
| Primary Stocks | 152.165 | 153.693 | 150.916 |
| **MIDDLE DISTILLATES** | | | |
| Refinery Output | 1.945 | 1.903 | 1.815 |
| Refinery Demand | 1.326 | 1.323 | 1.415 |
| Primary Stocks | 176.955 | 167.047 | 165.160 |
| **RESIDUALS** | | | |
| Refinery Output | 1.071 | 1.106 | 1.086 |
| Imports | .278 | .309 | .279 |
| Total Supply | 1.349 | 1.415 | 1.365 |
| Refinery Demand | 1.340 | 1.378 | 1.368 |
| Primary Stocks | 46.700 | 46.551 | 56.702 |

*Through Sept. 16

## PRODUCT AND CRUDE PRICES

(Products—¢ gal., weighted average prices in principal refinery markets)
Crudes—$/bbl., principal fields
Source—Platt's Oilgram Price Service

| | Sept. 1955* | Aug. 1955 | Sept. 1954 |
|---|---|---|---|
| Gasoline | 11.76 | 11.56 | 11.38 |
| Distillate Fuel Oil | 8.90 | 8.91 | 8.78 |
| Kerosine | 10.40 | 10.40 | 10.25 |
| Residuals | 4.75 | 4.74 | 3.89 |
| Above 4 Products | 9.16 | 9.06 | 8.68 |
| Lube Oils | 17.74 | 17.44 | 16.30 |
| Crude | 2.82 | 2.82 | 2.81 |

## REFINERY YIELDS

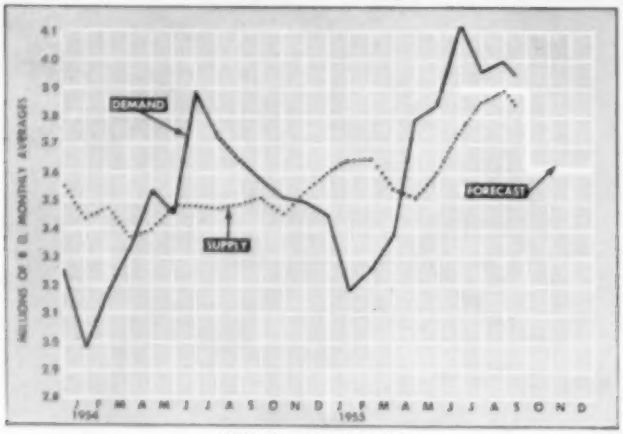
% on Crude Runs to Stills

| | Sept. 1955* | Aug. 1955 | Sept. 1954 |
|---|---|---|---|
| Gasoline | 44.9 | 45.3 | 43.6 |
| Kerosine | 3.9 | 3.9 | 4.3 |
| Distillate | 21.9 | 21.1 | 21.5 |
| Residuals | 14.2 | 14.6 | 15.4 |

*Through Sept. 16

SOURCE OF DATA (except prices): July, Aug. and Sept., API weekly reports; earlier months, Bureau of Mines

## *Seasonal Drop in Gasoline Demand Is Delayed*

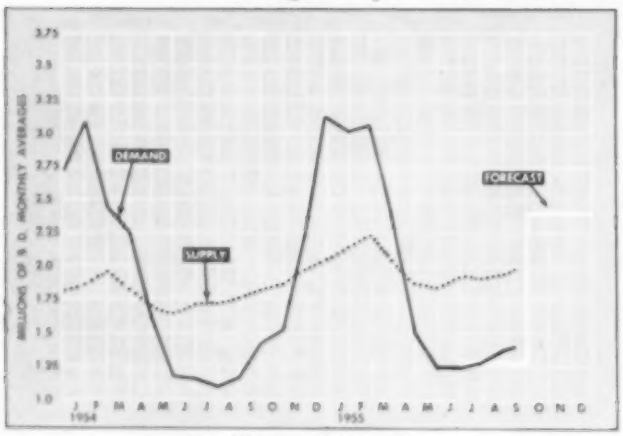



1955 figures to Sept. 16

**MOTOR FUELS**

| | From Crude | From Nat. Gas. | Total |
|---|---|---|---|
| **SUPPLY (Millions of b/d)** | | | |
| Aug. '55 | 3.440 | .443 | 3.883 |
| Aug. '54 | 3.058 | .434 | 3.492 |
| Change | + .382 | + .009 | + .391 |
| % Change | +12.5 | +2.1 | +11.2 |
| **DEMAND (including Exports) (Millions of b/d)** | | | |
| Aug. '55 | | | 3.985 |
| Aug. '54 | | | 3.649 |
| Change | | | + .336 |
| % Change | | | +9.2 |
| **TOTAL SUPPLY (Millions of bbls.)** | | | |
| 8 Mos. '55 | 790.593 | 102.302 | 892.895 |
| 8 Mos. '54 | 738.592 | 100.419 | 839.011 |
| Change | + 52.001 | + 1.883 | + 53.884 |
| % Change | + 7.1 | +1.9 | + 6.4 |
| **TOTAL DEMAND (including Exports) (Millions of bbls.)** | | | |
| 8 Mos. '55 | | | 899.606 |
| 8 Mos. '54 | | | 843.993 |
| Change | | | + 55.613 |
| % Change | | | + 6.6 |

## *Strong Early Fall Demand for Distillate Fuels*

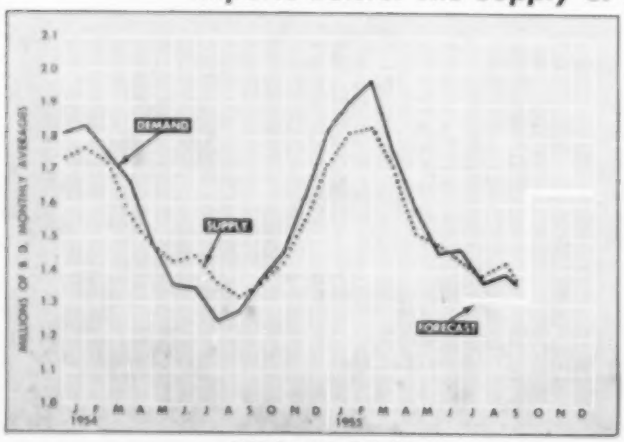



1955 figures to Sept. 16

**MIDDLE DISTILLATES**

| | Kerosine | Dist. Fuel Oil | Total |
|---|---|---|---|
| **PRODUCTION (Millions of b/d)** | | | |
| Aug. '55 | .297 | 1.606 | 1.903 |
| Aug. '54 | .302 | 1.453 | 1.755 |
| Change | — .005 | + .153 | + .148 |
| % Change | —1.7 | +10.5 | +8.4 |
| **DEMAND (including Exports) (Millions of b/d)** | | | |
| Aug. '55 | .214 | 1.109 | 1.323 |
| Aug. '54 | .205 | .968 | 1.173 |
| Change | + .009 | + .141 | + .150 |
| % Change | +4.4 | +14.6 | +12.8 |
| **TOTAL PRODUCTION (Millions of bbls.)** | | | |
| 8 Mos. '55 | 78.904 | 399.466 | 478.370 |
| 8 Mos. '54 | 81.276 | 348.589 | 429.865 |
| Change | — 2.372 | + 50.877 | + 48.505 |
| % Change | — 2.9 | + 14.6 | + 11.3 |
| **TOTAL DEMAND (including Exports) (Millions of bbls.)** | | | |
| 8 Mos. '55 | 71.977 | 377.085 | 449.062 |
| 8 Mos. '54 | 75.011 | 347.038 | 422.049 |
| Change | — 3.034 | + 30.047 | + 27.013 |
| % Change | — 4.0 | + 8.7 | + 6.4 |

## *Imports Bolster the Supply of Residual Fuel Oils*




1955 figures to Sept. 16

**RESIDUAL FUELS**

| | Refinery Output | Imports | Total |
|---|---|---|---|
| **SUPPLY (Millions of b/d)** | | | |
| Aug. '55 | 1.106 | .309 | 1.415 |
| Aug. '54 | 1.069 | .249 | 1.318 |
| Change | + .037 | + .060 | + .097 |
| % Change | +3.4 | +24.1 | +7.4 |
| **DEMAND (including Exports) (Millions of b/d)** | | | |
| Aug. '55 | | | 1.378 |
| Aug. '54 | | | 1.272 |
| Change | | | + .106 |
| % Change | | | +8.3 |
| **TOTAL SUPPLY (Millions of bbls.)** | | | |
| 8 Mos. '55 | 278.601 | 100.613 | 379.216 |
| 8 Mos. '54 | 280.742 | 84.867 | 365.609 |
| Change | — 2.139 | + 15.746 | + 13.607 |
| % Change | — 0.8 | + 18.5 | + 3.7 |
| **TOTAL DEMAND (including Exports) (Millions of bbls.)** | | | |
| 8 Mos. '55 | | | 387.884 |
| 8 Mos. '54 | | | 362.595 |
| Change | | | + 25.289 |
| % Change | | | + 6.9 |

1955 figures to Sept. 16

SOURCE OF DATA: July, Aug. and Sept., API weekly reports; earlier months, Bureau of Mines

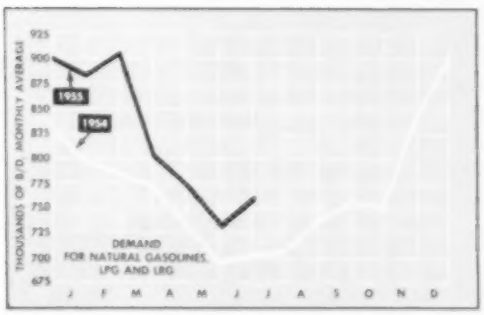
## RUNS TO STILLS AND DISTRIBUTION OF PRIMARY STOCKS BY U. S. REFINERY DISTRICTS

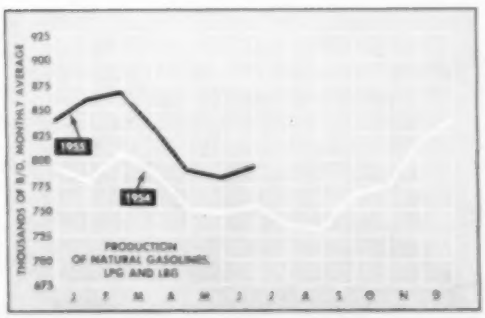
(Primary stocks include those at refineries, at large terminals and in pipelines; all data based on API reports)

| | RUNS TO STILLS (Millions of b/d average for week ending on date shown) | | | | GASOLINE STOCKS (Millions of bbls., on date shown) | | | | RESIDUAL STOCKS (Millions of bbls., on date shown) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sept. 16 1955 | Sept. 17 1954 | Change | % Change | Sept. 16 1955 | Sept. 17 1954 | Change | % Change | Sept. 16 1955 | Sept. 17 1954 | Change | % Change |
| East Coast | 1.067 | .983 | + .084 | + 8.5 | 34.722 | 34.601 | + .121 | + 0.3 | 12.894 | 11.142 | +1.752 | +15.7 |
| Gulf Coast | 2.459 | 2.308 | + .151 | + 6.5 | 29.900 | 28.260 | +1.640 | + 5.8 | 8.732 | 8.583 | + .149 | + 1.7 |
| Total Coastal | 3.526 | 3.291 | + .235 | + 7.1 | 64.622 | 62.861 | +1.761 | + 2.8 | 21.626 | 19.725 | +1.901 | + 9.6 |
| Appalachian | .197 | .182 | + .015 | + 8.2 | 6.370 | 6.415 | — .045 | — 0.7 | .924 | .762 | + .162 | +21.3 |
| Ind.-Ill.-Ky. | 1.265 | 1.219 | + .046 | + 3.8 | 31.037 | 34.319 | —3.282 | — 9.6 | 4.707 | 4.759 | — .052 | — 1.1 |
| Okla.-Kans.-Mo. | .717 | .596 | + .121 | +20.3 | 15.006 | 14.561 | + .445 | + 3.1 | 1.338 | 1.188 | + .150 | +12.6 |
| Other Inland | .640 | .602 | + .038 | + 6.3 | 15.007 | 15.422 | — .415 | — 2.7 | 2.315 | 2.329 | — .014 | — 0.6 |
| Total Inland | 2.819 | 2.599 | + .220 | + 8.5 | 67.420 | 70.717 | —3.297 | — 4.7 | 9.284 | 9.038 | + .246 | + 2.7 |
| Total East of Calif. | 6.345 | 5.890 | + .455 | + 7.7 | 132.042 | 133.578 | —1.536 | — 1.1 | 30.910 | 28.763 | +2.147 | + 7.5 |
| Calif. | 1.126 | 1.079 | + .047 | + 4.4 | 20.123 | 18.209 | +1.914 | +10.5 | 15.790 | 28.505 | —12.715 | +44.6 |
| Total U. S. | 7.471 | 6.969 | + .502 | + 7.2 | 152.165 | 151.787 | + .378 | + 0.2 | 46.700 | 57.268 | —10.568 | —18.5 |

| | DISTILLATE FUEL OIL STOCKS (Millions of bbls on date shown) | | | | KEROSINE STOCKS (Millions of bbls., on date shown) | | | | TOTAL MIDDLE DISTILLATE STOCKS (Millions of bbls., on date shown) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sept. 16 1955 | Sept. 17 1954 | Change | % Change | Sept. 16 1955 | Sept.17 1954 | Change | % Change | Sept. 16 1955 | Sept. 17 1954 | Change | % Change |
| East Coast | 51.625 | 44.303 | + 7.322 | +16.5 | 13.948 | 15.041 | —1.093 | — 7.3 | 65.573 | 59.344 | +6.229 | +10.5 |
| Gulf Coast | 21.354 | 19.439 | + 1.915 | + 9.9 | 6.342 | 7.569 | —1.227 | —16.2 | 27.696 | 27.008 | + 6.88 | + 2.5 |
| Total Coastal | 72.979 | 63.742 | + 9.237 | +14.5 | 20.290 | 22.610 | —2.320 | —10.3 | 93.269 | 86.352 | +6.917 | + 8.0 |
| Appalachian | 4.093 | 2.816 | + 1.277 | +45.3 | 1.295 | 1.091 | + .204 | +18.7 | 5.388 | 3.907 | +1.481 | +37.9 |
| Ind.-Ill.-Ky. | 27.508 | 25.045 | + 2.463 | + 9.8 | 9.395 | 9.615 | — .220 | — 2.3 | 36.903 | 34.660 | +2.243 | + 6.5 |
| Okla.-Kans.-Mo. | 15.280 | 12.903 | + 2.377 | +18.4 | 2.450 | 2.419 | + .031 | + 1.3 | 17.730 | 15.322 | +2.408 | +15.7 |
| Other Inland | 8.078 | 6.679 | + 1.399 | +20.9 | 1.956 | 1.543 | + .413 | +26.8 | 10.034 | 8.222 | +1.812 | +22.0 |
| Total Inland | 54.959 | 47.443 | + 7.516 | +15.8 | 15.096 | 14.668 | + .428 | + 2.9 | 70.055 | 62.111 | +7.944 | +12.8 |
| Total East of Calif. | 127.938 | 111.185 | +16.753 | +15.1 | 35.386 | 37.278 | —1.892 | — 5.1 | 163.324 | 148.463 | +14.861 | +10.0 |
| California | 13.291 | 12.836 | + .455 | + 3.5 | .340 | .366 | — .026 | — 7.1 | 13.631 | 13.202 | + .429 | + 3.2 |
| Total U. S. | 141.229 | 124.021 | +17.208 | +13.8 | 35.726 | 37.644 | —1.918 | — 5.1 | 176.955 | 161.665 | +15.290 | + 9.5 |

## *Natural Gas and Refinery Gas Liquids*




### SUPPLY AND DEMAND STATISTICS

(Bureau of Mines Data)

| | June 1955 | May 1955 | June 1954 |
|---|---|---|---|
| **CURRENT PRODUCTION** (1000 b d monthly average) | | | |
| At Natural Gasoline and Cycling Plants | | | |
| Liquefied Petroleum Gas | 313 | 317 | 299 |
| Natural Gasoline and Isopentane | 278 | 280 | 274 |
| Condensate | 20 | 15 | 27 |
| Finished Gasoline, Naphtha and other | 61 | 59 | 59 |
| Total Natural Gasoline and Cycling Plant Production | 672 | 671 | 659 |
| Liquefied Refinery Gases | 123 | 111 | 94 |
| Total Marketable Gas Liquids | 795 | 782 | 753 |
| Lease Condensate | 103 | 111 | 99 |
| Total Natural Gas Liquids | 898 | 893 | 852 |
| **CURRENT DEMAND** (1000 b d monthly average) | | | |
| LPG and LRG | 387 | 371 | 354 |
| Natural Gasoline, Isopentane and Other | 378 | 366 | 349 |
| Total Marketable Gas Liquids | 765 | 737 | 703 |

| | June 1955 | June 1954 |
|---|---|---|
| **CUMULATIVE PRODUCTION** (1000 bbls.) | | |
| LPG and LRG | 83,986 | 59,042 |
| Natural Gasoline, Isopentane and Other | 64,635 | 17,189 |
| Total Marketable Gas Liquids | 148,621 | 76,231 |
| **CUMULATIVE DEMAND** (1000 bbls.) | | |
| LPG and LRG | 81,638 | 61,474 |
| Natural Gasoline, Isopentane and Other | 65,051 | 52,594 |
| Total Marketable Gas Liquids | 146,689 | 114,068 |

| | June 1955 | May 1955 | June 1954 |
|---|---|---|---|
| **STOCKS** (1000 bbls., end of month) | | | |
| LPG and LRG | 10,105 | 8,634 | 8,616 |
| Natural Gasoline, Isopentane and Other | 4,242 | 4,792 | 4,958 |
| Total Stocks | 14,347 | 13,426 | 13,574 |

**kaiser engineers** *will design and construct your new*

# *fluid coker*

Kaiser Engineers, designers and builders for the petroleum industry, has been appointed by Esso Research and Engineering Company to design and construct Fluid Coking Units for its licensees.

# *plus*

Not only is this firm qualified to engineer and build the Fluid Coker itself, but Kaiser Engineers also has the background and specialized knowledge necessary for the handling and utilization of this versatile new industrial material.

To take *full* advantage of the new Fluid Coking Process, call or write Kaiser Engineers.

**kaiser | engineers** ...*for low operating costs*

DIVISION OF | HENRY J. KAISER COMPANY

ENGINEERS K CONTRACTORS

● HOME OFFICE: KAISER BUILDING, OAKLAND 12, CALIFORNIA (CABLE: KAISENGS) NEW YORK, PITTSBURGH, WASHINGTON, D. C.
● HENRY J. KAISER CONSTRUCTION CO. ● HENRY J. KAISER COMPANY (Canada) LTD., MONTREAL ● KAISER ENGINEERS INTERNATIONAL, INC.

PETROLEUM CHEMICALS DIVISION
# NEWS

October ★ One of a Series of Interest to the Petroleum Industry ★ 1955

## A symbol of SERVICE in every community

To the American motorist, the words "petroleum products" and "service" have become almost synonymous.

But the typical American service station stands for more than just automotive service. It stands for *service to the community*, too . . . because the man who operates the station is a *good neighbor*, the kind of man you can count on to take an active part in civic, church and club affairs. And behind the service stations are the thousands of oil company employees and distributors who work together – not just during Oil Progress Week – but 52 weeks a year to make oil progress an important part of the over-all progress of our whole American community.

A PORTRAIT OF PROGRESS

## "Speak to the Earth" is a book about oil and oil people

"A new and refreshing book about oil . . . the growth of a great industry in terms of human endeavor and almost super-human achievement!"

We think you'll agree with this statement, too, after you have read "Speak to the Earth," the new book covering the oil industry by Max Miller, well-known author of "I Cover the Waterfront" and 22 other books. The book explains exploration, drilling, production, transportation, refining and marketing, in an easy-going, realistic, yet entertaining style.

Max Miller was retained by the Du Pont Company to write the story. And to help promote a better understanding of the oil industry, the book is now being made available to the public at book stores by its publisher, Appleton-Century-Crofts, Inc.

# New survey studies dealer knowledge of product quality and sales assets

That old familiar phrase, "know your product," is still a cardinal rule of good selling. And since your service station dealers are your main link with the motoring public, their knowledge of your product features can have a mighty important bearing on your own sales volume.

But how much does the average service station dealer really know about the products he sells? To help you answer this question accurately and statistically, Report No. 2 of the new Du Pont survey on "The Service Station Operator" is now ready for distribution to oil company marketing executives. Here is a quick preview of the type of information it contains.

**HOW MUCH** do dealers know about the additives in the gasolines they sell? This new Du Pont survey can help you answer this question.

The report discusses the dealer's knowledge of the products he sells, including his knowledge of additives and their functions, his opinion of what his greatest gasoline sales assets are, and his knowledge of gasoline pricing.

### "What's the difference?"

Our researchers asked this question in regard to the difference between "regular" and "premium" grades. Two-thirds of the dealers mentioned *octane number* as the chief difference. And many of them answered in terms of customer benefits – such as power and pick-up, antiknock, starting and warm-up qualities, and mileage.

But what about brand differences? The dealers' answers to this question may be quite significant–although not as encouraging. Nearly two-thirds of the dealers said they felt the premium gasolines sold by the major oil companies were pretty much the same . . . and more than two-thirds felt that the regular gasolines were pretty much the same, too. But of those who felt there was a difference, two-thirds said their own brand was superior.

The survey also documents the dealers' knowledge of motor oil quality. In this respect it is interesting to note that,

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *Dealer Survey*

when discussing the difference between grades of oil, more than half of the dealers mentioned the *detergency* of the oil.

### Other factors

The dealers' knowledge of the additive content of the petroleum products they sell was also probed . . . as was their knowledge of prices in their local marketing area. And the survey included questions about tires, batteries and such services as chassis lubrication and automatic transmission service.

### Their own sales assets

To the question, "What do you consider your greatest sales asset?" the dealers returned a wide variety of answers. You'll probably find this page the most interesting and significant in the whole report. It includes the dealers' own relative ratings of such factors as brand, station location and hours, advertising, service, friendship, and many more.

### Regional breakdowns

Although the dealer survey is nationwide in scope, it is broken down regionally according to the four main marketing areas of the country. Because of this, it will be extremely helpful to regional as well as national marketers.

Sponsored by Du Pont, the survey was conducted by National Analysts, Inc., on a completely impartial basis. The results are being published in a series of five reports. The first covers station hours and rush periods, gallonage sold, customer credit, and the use of customer mailing lists.

### Now available

Both Reports No. 1 and 2 are now available to marketing executives through any of our regional offices listed below. The remaining three reports will be issued periodically during the next six months.

### Continuing market research

This survey on "The Service Station Operator" is part of the continuing market research work of the Du Pont Petroleum Chemicals Division. Another part of this program is the Du Pont survey of service station customer buying habits.

## CENTRAL REGION LAB MANAGER

ARTHUR R. KERNEN joined the Du Pont Company in 1947 after receiving his M.S. degree in chemistry at the University of Delaware.

His first assignment was as a research chemist at the Du Pont Petroleum Laboratory. Following this he did both development and sales-service work on gasoline additives and stability problems.

In September, 1953 he was appointed manager of the Petroleum Chemicals Division's Central Region laboratory in Chicago. He is in charge of customer service in product testing and analysis and additives treating recommendations.

Before beginning his graduate work, he received a B.S. degree at the University of Notre Dame. He also attended Xavier University in Cincinnati, Ohio.

ARTHUR R. KERNEN

Mr. Kernen is a member of the Society of Automotive Engineers and the American Chemical Society.

## Du Pont's Fuel-Injection Test Car Hits the Road

In view of the possibility that many automobiles will soon be equipped with fuel-injection engines, a special fuel-injection system was added to a Lincoln car at the Du Pont Petroleum Laboratory in 1954. The purpose of this car is to study the possible advantages of fuel injection to the refining industry.

From testing a variety of gasoline blends in the fuel-injection engine, it has been found that fuel-injection permits greater flexibility in blending fuels. Higher vapor pressures can be used, and it is possible that increases in end point might be practical. These wider tolerances could mean a substantial benefit to refiners and the motoring public.

The car has a standard Lincoln V-8 engine to which has been added an American Bosch fuel-injection system and special instrumentation. The system gives freedom from carburetor icing, relief from vapor lock troubles, improved power, and permits styling changes since the hood lines can be lowered with the less bulky fuel-injection pump.

For studying the performance of different gasolines in the fuel-injection engine, the Petroleum Laboratory has tested the car on the laboratory's chassis dynamometer. The Petroleum Chemicals Division has also made plans for the car to make a demonstration tour.

DU PONT

Better Things for Better Living
. . . through Chemistry

# Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

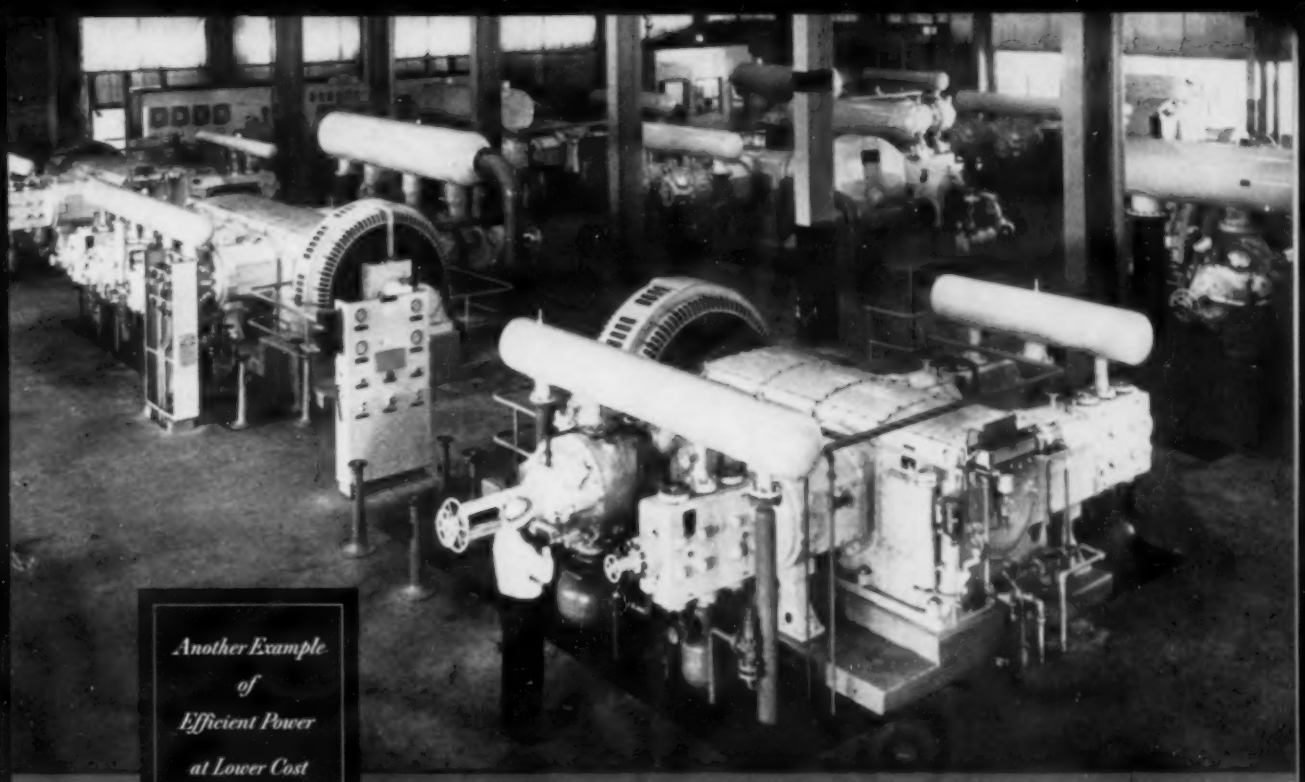
*Regional Offices:*
NEW YORK, N. Y.—1270 Ave. of the Americas Phone COlumbus 5-2342
CHICAGO, ILL.—8 So. Michigan Ave. Phone RAndolph 6-8630
TULSA, OKLA.—P. O. Box 730 Phone LUther 5-5578
HOUSTON, TEXAS—705 Bank of Commerce Bldg. Phone CApitol 5-1151
LOS ANGELES, CALIF.—612 So. Flower St. Phone MAdison 5-1691

IN CANADA: Du Pont Company of Canada Limited—Petroleum Chemicals Division, 80 Richmond Street West, Toronto 1, Ontario
OTHER COUNTRIES: Petroleum Chemicals Export—Nemours Bldg., 6539—Wilmington 98, Del.

*ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)*



Printed in U. S. A.



*Another Example of Efficient Power at Lower Cost*

This over-all plant view shows several of the compact Cooper-Bessemer M-Line compressor units that deliver dependable performance in the Brea Chemicals, Inc. modern ammonia plant near Los Angeles.

# HERE'S MULTIPLE-SERVICE FLEXIBILITY IN MODERN AMMONIA PRODUCTION

## *. . . with Cooper-Bessemer JM Compressors*

● Twelve Cooper-Bessemer JM compressors, totaling 17,500 horsepower, are doing an efficient, economical job of handling a wide range of compressor services in the Brea Chemicals, Inc. 13-million-dollar ammonia plant near Los Angeles.

JM-4's for air, ammonia, mixed gas, hydrogen and recycle service, and JM-6's handling nitrogen compression, offer important savings to this producer of 235 tons of ammonia daily.

Here, to list but a few, are reasons why Brea, like so many other modern chemical producers, benefits from Cooper-Bessemer's century of compressing experience: there's extreme flexibility to handle a wide range of pressures and different gases, advanced design and metallurgy afford unusual strength and rigidity, there's five-step unloading at constant speed, the crankshaft is a steel forging of exceptionally large diameter thus low unit bearing pressures, compressor cylinder jackets are designed to insure adequate, uniform cooling, and the JM's exceptional compactness does not sacrifice accessibility or ruggedness.

If you're interested in compressing, write or call for full details . . . learn about *all* the plus features of these modern units. The nearest Cooper-Bessemer office will gladly cooperate.

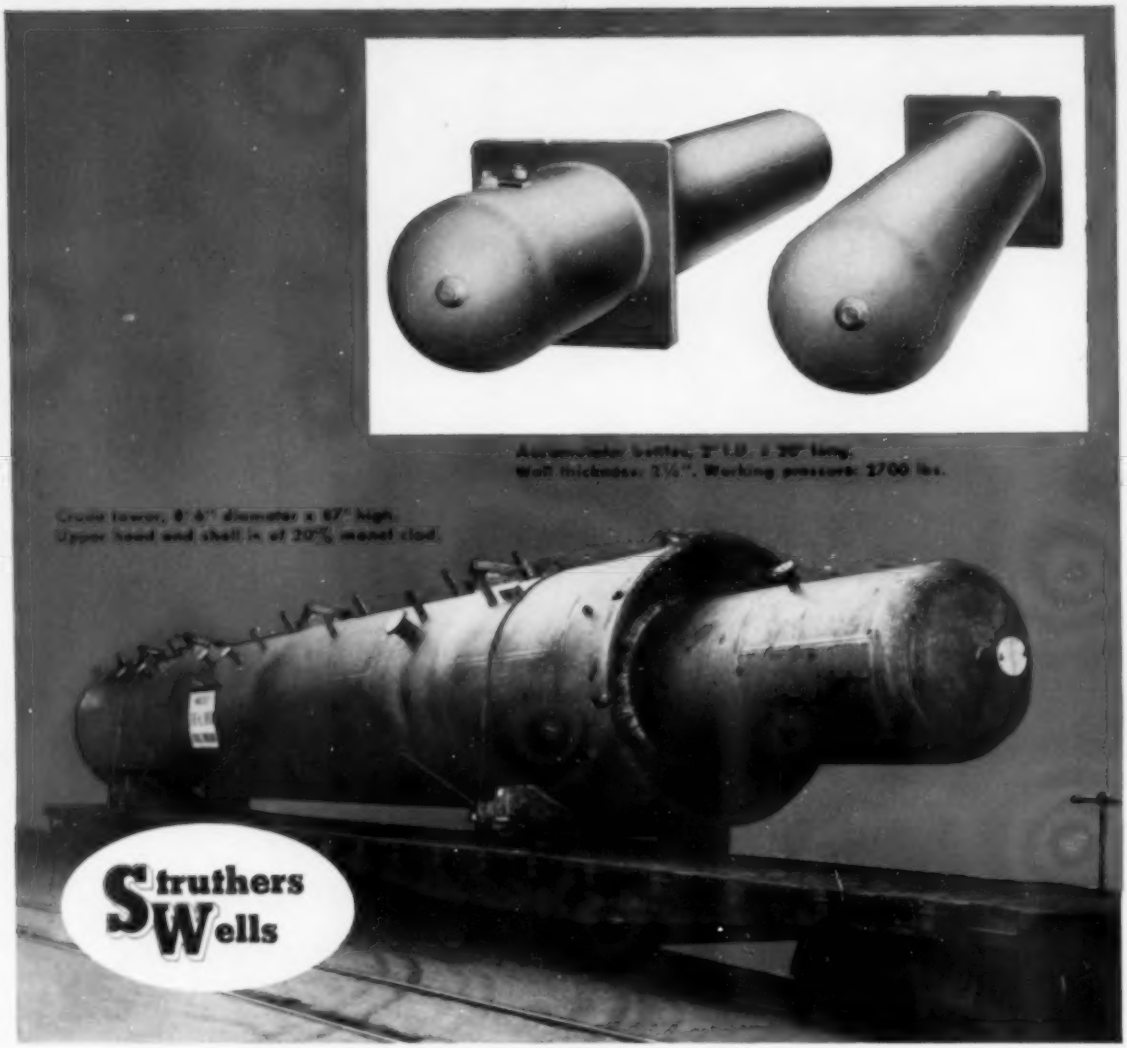
MOUNT VERNON, OHIO

**COOPER-BESSEMER**

GROVE CITY, PENNA.

New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS




# DEPENDABLE PROCESSING PERFORMANCE IS ASSURED

## *...when Equipment is Designed and Fabricated by Struthers Wells*

Process equipment such as that illustrated above constantly rolls out of our modern, efficient plants—to meet the exacting specifications and delivery requirements of valued customers in the chemical and petroleum processing industries. Intensive experience in the design and fabrication of standard or specialized processing equipment—regardless of size, specifications or codes—has built an enviable reputation for us in the construction of highest quality products that provide service of utmost satisfaction. Yes . . . in choosing Struthers Wells as your process equipment fabricator—efficient, safe, economical and long life performance is assured.

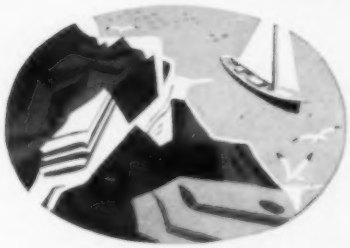
Struthers Wells

**STRUTHERS WELLS**
CORPORATION
TITUSVILLE, PA.

Plants at Titusville and Warren, Pa.
*Offices in principal cities*

# HARSHAW
# *Tableted*
# CATALYSTS

FROM **strong**



**as rock!**

TO *soft*

*as chalk!*

## whatever you specify

**Typical Harshaw Catalysts:**

Aluminum Chloride Anhydrous
Boron Trifluoride
Boron Fluoride Addition Compounds
Hydrofluoric Acid Anhydrous
Alumina—active or inert
Chrome Alumina
Molybdena Alumina
Tungsten Alumina
Cobalt Molybdena Alumina
Copper-Chromium Oxide
Magnesia
Nickel
Vanadium
Zinc-Chrome

**Harshaw Catalysts available in these forms:**

Tablets
Extrusions
Powders
Granules
Spheres
Rings
Flakes

**Use Harshaw Catalysts for these processes:**

Hydroforming
Cyclization
Oxidation
Dehydrogenation
Hydrogenation
Dehydration
Desulphurization
Alkylation
Isomerization

Harshaw Catalysts—made exactly to your specifications of raw materials, chemical composition, and physical properties such as length, diameter, crushing strength, abrasion resistance, bulk density, etc. AND delivered when you want them!

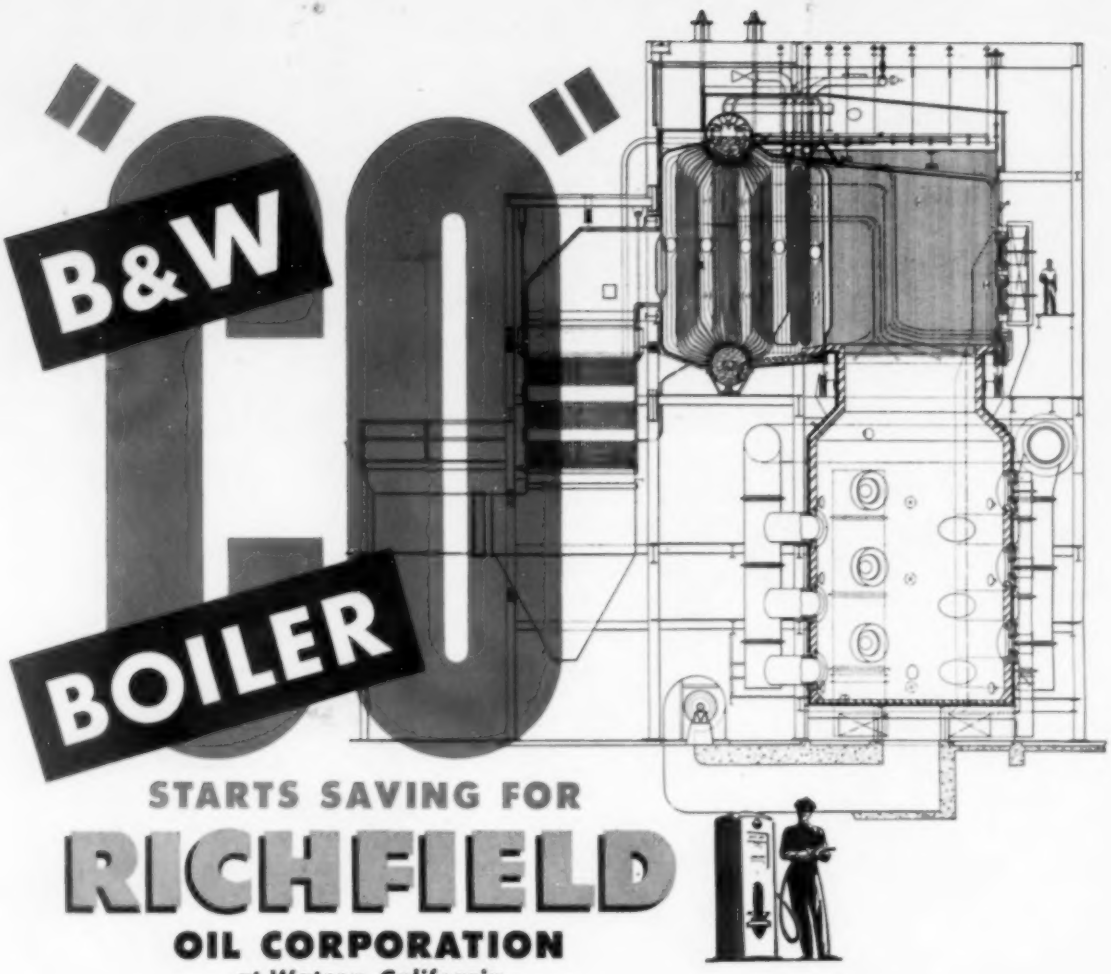
Harshaw has the know-how—we pioneered in making customer specified catalysts. Harshaw has the facilities—we produce carloads every week!

We are to you like the druggist is to the doctor . . . write your catalyst prescription and depend on Harshaw to fill it.

Our free booklet "Harshaw Catalysts" is yours for the asking. Write today.

**The HARSHAW CHEMICAL Co.**
CLEVELAND 6, OHIO

CHICAGO • CINCINNATI • CLEVELAND • DETROIT • HOUSTON • LOS ANGELES
HASTINGS-ON-HUDSON • PHILADELPHIA • PITTSBURGH




## STARTS SAVING FOR

# RICHFIELD

## OIL CORPORATION

***at Watson, California***

Another big stride in waste heat reclamation was made at Richfield's Watson refinery when their new B&W CO (Carbon Monoxide) Boiler recently went on stream.

Utilizing the combustible carbon monoxide, as well as sensible heat, from the catalyst regenerator, the CO Boiler saves heat previously expelled to the atmosphere and wasted. From now on this heat will be burned and harnessed—a saving that is reckoned in thousands of dollars.

In addition, the boiler is an independent source of steam power for the entire fluid unit and its auxiliaries—available for steam even when the cracking unit is shut down.

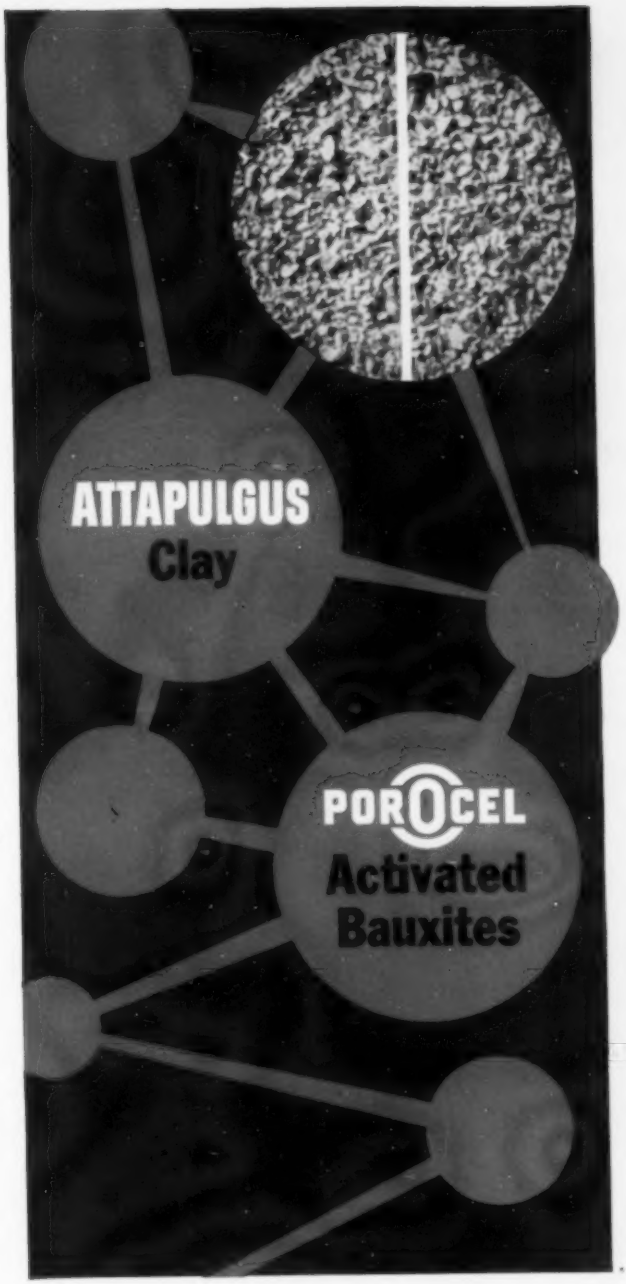
Its maximum continuous capacity is 340,000 lb of steam per hr at a pressure of 600 psi and a temperature of 750 F, burning either oil or gas as supplementary fuels.

G-719

Besides representing a significant economic advance, the CO Boiler is an outstanding example of cooperation among companies with the common goal of lowering operating costs and raising an already outstanding efficiency still higher. C. F. Braun Company, the contractors, Richfield Oil Corp., and B&W—all are major contributors to what is rapidly proving to be a *saving* advance in the petroleum industry. Let us discuss with you and with your consulting engineers the working advantages of the B&W CO Boiler and give you additional details. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

**BABCOCK & WILCOX**

BOILER DIVISION




# *Here's the way to tackle a sorptive-mineral job*

Away up in number two slot in a list of nearly 2,000 different chemicals used in petroleum refining operations is *sorptive minerals*. And the adsorbents recognized as standards in the industry are Minerals & Chemicals products—Attapulgus Clay . . . Porocel Activated Bauxites. That means there's a *headquarters* to turn to!

*Want To Purify By Adsorption?* There's an M&C adsorbent to fit your process scheme for removing odors, colors, taste, moisture, acids, sulfur compounds, fluorides and unsaturates from process liquids or gases.

*Catalyst Carrier?* M&C sorptive minerals are of highest importance in a wide variety of hydrocarbon conversion and sweetening processes.

*What Do You Want To Dry?* M&C offers a complete line of reliable desiccants for drying air, hydrogen, $CO_2$, hydrocarbon liquids and gases.

HERE'S THE NEWEST APPLICATION *of sorptive minerals in the petroleum field. Mail the coupon for your free copy of "Preparation of Petroleum Feeds for Platinum Catalysts"—and for other assistance if desired.*

ATTAPULGUS *and* POROCEL PRODUCTS *from*

MINERALS & CHEMICALS CORPORATION OF AMERICA
210 W. WASHINGTON SQUARE, PHILADELPHIA 5, PA.

ALWAYS A BETTER WAY . . .

MINERALS & CHEMICALS CORPORATION OF AMERICA
Dept. W, 210 W. Washington Square, Philadelphia 5, Pa.

☐ Please send me "Preparation of Petroleum Feeds For Platinum Catalysts."

☐ Please provide technical help (and samples) on the following proposed applications: _____

name _____ title _____

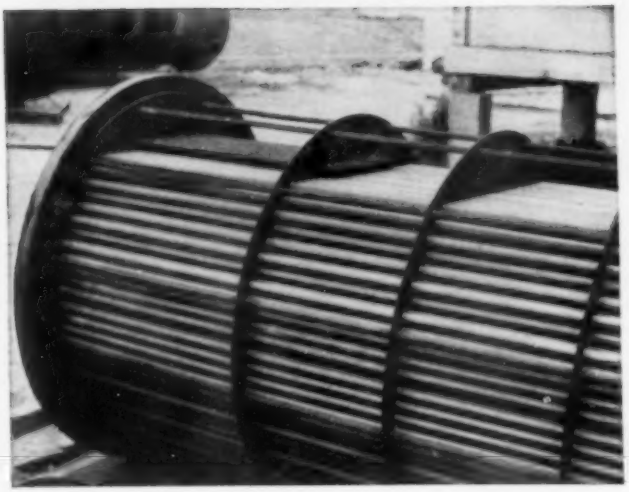
company _____

address _____

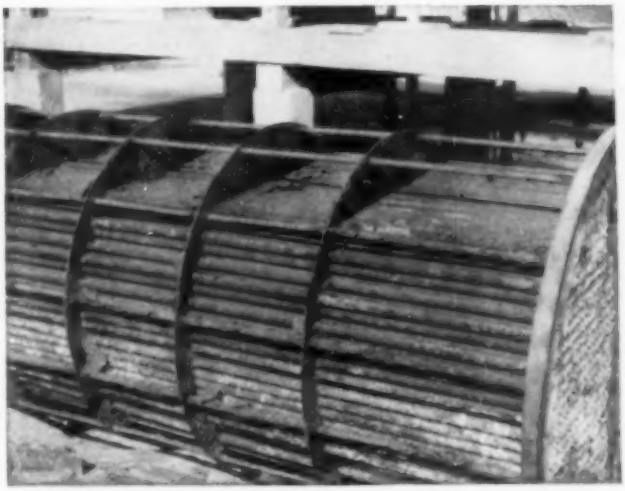
city _____ zone _____ state _____

# Which bundle do you want to find

## at turn-around time?



**This?..** Here's what a refiner likes to see when he pulls his bundles at turn-around time. This clean, uncorroded appearance is typical of what can be expected when you use Polyrad.



**or this?..** This is an all too common sight at turn-around time. Corroded and fouled bundles such as these call either for costly replacement, repair, or cleaning.

These two bundles from the overhead condensing system of a Gulf Coast refinery tell a story. One is what the refiner likes to find at turn-around time; the other, what he is likely to discover without Polyrad.

More and more refineries have found that when they use Polyrad, the filming amine inhibitor, they can expect to find bundles free of corrosion, ready for immediate return to service. As a result turn-around time no longer need be headache time.

Why not make use of Polyrad's detergency to maintain throughput, increase heat transfer, and cut down time for maintenance?

Stocks of Polyrad are maintained throughout the country. A Hercules technical representative will be glad to discuss its application to your operating conditions.

**POLYRAD®**

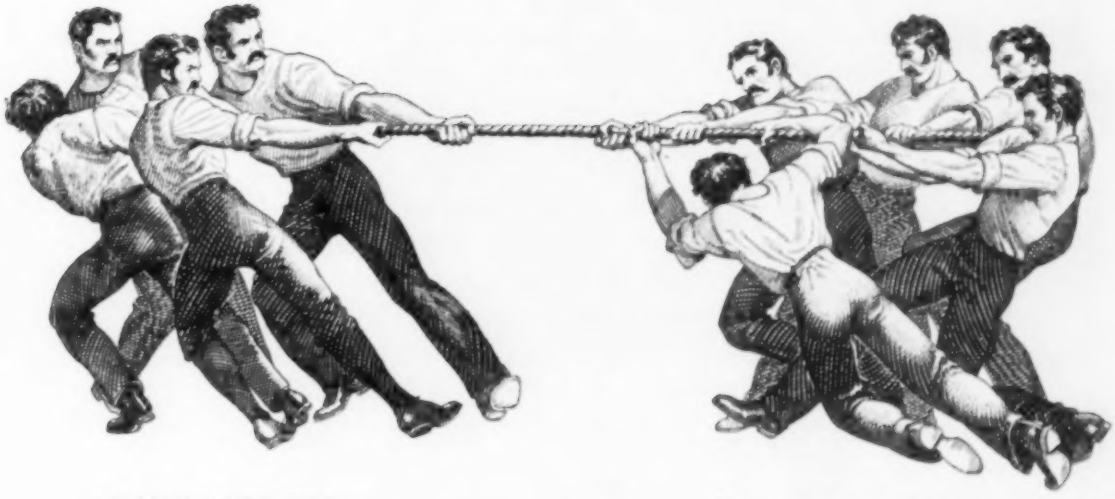
**FILMING AMINE INHIBITOR**

*Pine Chemicals Division, Naval Stores Dept.* **HERCULES POWDER COMPANY** *984 King Street, Wilmington 99, Delaware*

NAS6-5

*boost production*
*with the Ljungstrom® Air Preheater*

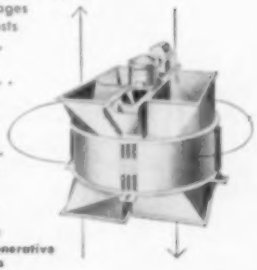
4 *of your units*
*can do*
*the*
*work of* 5



**HOW FAST IS "WRITE OFF"?**

In most cases, the Ljungstrom installation is quickly written off by increased capacity alone. Write-off time is even less when the other Ljungstrom advantages are considered — saves up to 20% of fuel costs . . . permits more economical furnace design, with no need for convection surfaces . . . burns many fuels you used to throw away . . . results in consistently higher through-put . . . and minimizes slag.

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits attainable in fuel burning equipment — call or write The Air Preheater Corporation.



*Wherever You Burn Fuel, You Need Ljungstrom*

**The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.**

Recover waste heat, return it to the furnace as combustion air, and you naturally generate higher flame temperatures . . . increase heat-transfer rates — *which means more through-put.*

That's why four of your present processing units can do the work of five *with Ljungstrom Air Preheaters increasing each unit's output as much as 25%*. One eastern refinery increased the continuous capacity of a pipe still from 16,000 to 18,000/20,000 barrels a day — by modernizing and including a Ljungstrom.

**The Air Preheater Corporation** 60 East 42nd Street, New York 17, N. Y.

# New Houdry Iso-Plus Process Reforms Low-Octane Naphthas Into 100-Octane Plus Gasoline

The new Houdry Iso-Plus Process reforms run-of-the-refinery low-octane naphthas into gasolines with octane ratings as high as 108-octane F-1 clear.

Conversion rates are extremely high. Variations of the Iso-Plus Process yield from 86% to 91% of naphtha charge stock into 100 octane gasoline. Up to 82% of the charge stock can be converted to 108 F-1 clear octane gasoline for blending with refinery pool gasolines of lower anti-knock ratings.

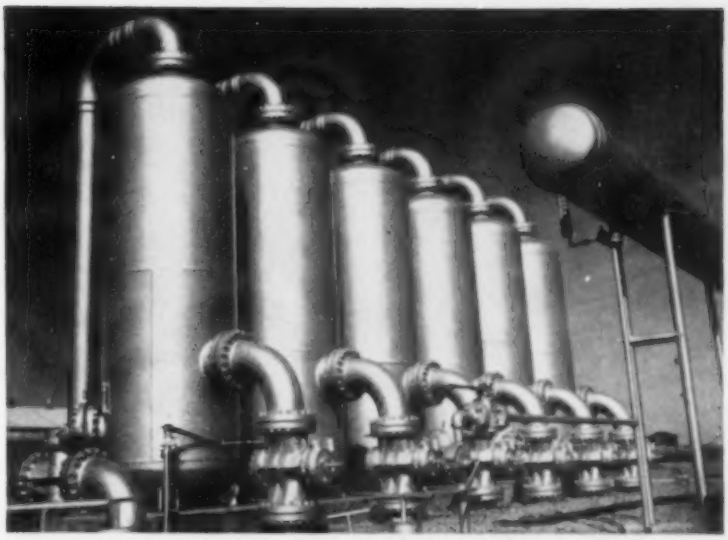
The development of Houdry Iso-Plus gives refiners a conclusive answer to the present high octane derby. With 300 h.p. automobile engines predicted for 1960, refiners are now planning their process facilities for the economical production of suitable fuels. Houdry Iso-Plus, already extensively tested in the pilot stage, can meet all high-octane requirements of the foreseeable future.

For further information, write to Houdry Process Corporation, 1528 Walnut Street, Philadelphia 2, Pennsylvania.

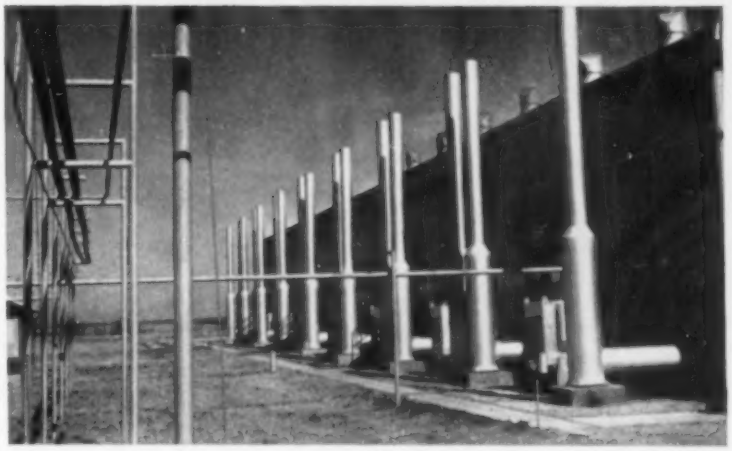
HOUDRY PROCESS CORPORATION

PIONEER IN CATALYTIC PROCESSES

Compressor station gas cleaners are coated with Morris' Chrome Aluminum Paint to protect against all corrosive conditions. Northern finds that the aluminum coating lasts longer, reduces maintenance costs.



# Northern Natural Gas Company *cuts maintenance costs* at this compressor station with Morris' High Heat Aluminum Paint



Exhaust mufflers at one of Northern's compressor stations. Operating under extremely hot conditions, these pipes are coated with **High Heat Silicone Aluminum Paint** manufactured by the **Morris Paint & Varnish Company, East St. Louis, Illinois.**

The Northern Natural Gas Company, Omaha, Nebraska, transmitting natural gas from Texas to Minnesota, is cutting compressor station maintenance costs with High Heat Silicone Aluminum Paint. This coating is used on "hot" exhaust mufflers on engines used to pump gas through the pipeline. Northern found that they had to repaint these surfaces several times a year until they tried high heat aluminum paint. Now the coating lasts from 1½ to 2 years, even under the hottest conditions. The company states that "the paint is doing an excellent job under the severe heat of Texas as well as in the cold temperatures found in Minnesota."

Other types of Morris' Aluminum Paint are used on various compressor station structures, with a resulting reduction in maintenance costs due to greater durability, high resistance to corrosion.

**ALCOA does not make paint,** but ALCOA Aluminum Pigments are used in more aluminum paints than any other brand. Special formulas, like High Heat Silicone, have been developed by your paint manufacturer to solve individual problems. Paints made to these formulas actually cost less, last longer, give utmost protection against heat, cold, sun, rain, smoke and fumes.

Write today for our two FREE booklets, *Painting With Aluminum*, and *Aluminum Asphalt Roof Coatings Make Time Stand Still*. They contain the latest, up-to-date information on aluminum paints and aluminum roof coatings. Use the coupon.

PIGMENTED WITH
ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Paint Service Bureau
Aluminum Company of America
1792-K Alcoa Building
Pittsburgh 19, Pennsylvania
Please send me your FREE booklets:
☐ Painting With Aluminum
☐ Aluminum Asphalt Roof Coatings Make Time Stand Still

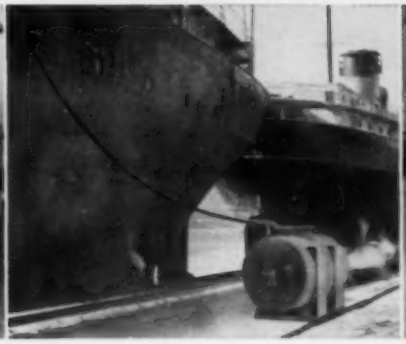
Name_____
Company_____
Address_____
City_____
Zone_____ State_____


*(To obtain more data on advertised products see page 1628)*

# Here's *MASS-HANDLING* of bulk

**What you see above is a Dempster-Dumpster serving one of its detachable containers. Multiply this simple pick-up, haul and dump operation by scores of steel containers built to meet your requirements for handling waste or salvable materials, raw and finished products, fluids including acids, combustibles, dusty materials, etc. You have, then, mass-handling of bulk materials with one truck and one man!**

Tilt Type Container is handling filter dirt at a plant in Illinois. Note container is equipped with casters and placed under chute, through which the filter dirt passes directly from presses. As each container is filled, it is replaced with an empty one.



Tank Type Container is being filled with used oil from a ship. Time required to haul loaded container to reclaim station, drain and return for refilling—10 minutes. Time cycle of the former method using conventional barrels—60 minutes.

A loaded Apartment Type Container, equipped with roller bearing casters, is being rolled to outside of this plant building. Dempster-Dumpster will pick it up, haul to disposal area, dump the refuse and return empty container for refilling.

Three heavy duty Drop Bottom Type Containers, shown below, are loaded with cast iron fittings from conveyor at plant in Birmingham. Dempster-Dumpster picks up each container when loaded and hauls the finished products to shipping department.

Here's another example of the many types of waste materials handled by this system. The Skip Type Container shown below is located under hydropulper at a paper plant. Picture was shot while container was being filled with rope waste sludge.

Waste materials are loaded into these Universal Containers at a food plant warehouse. Containers have lids in top, as well as a door in each end, which are opened to make deposits, then closed, sealing materials in container.

# materials with one truck...one man!

A FEW OF THE HUNDREDS of containers available are shown above in actual service. They are built in capacities up to 21 cu. yds.—several times the capacity of the average dump truck body. One Dempster-Dumpster, operated by only one man, the driver, serves scores of big detachable containers, one after another—handling materials of every description. It's like having one truck with scores of bodies!

Records of performance in dozens of installations prove beyond question that savings are tremendous! The Dempster-Dumpster System cuts costs of equipment and operation. It is common knowledge that one Dempster-Dumpster will perform the work of several conventional trucks, reducing investment accordingly. This system eliminates standing idle time and re-handling of materials. Once placed in these containers, materials remain there until hauled to destination. Efficiency, sanitation and good plantkeeping are big advantages. Materials to be transferred or disposed of are constantly being placed in the containers as they accumulate. Containers for handling refuse are fire-proof, rat-proof and scavenger proof.

With no obligation on your part, our engineers will be glad to make a comprehensive fact-finding survey to determine the cost-cutting possibilities of this equipment in your plant. Write us for complete information today! Manufactured exclusively by Dempster Brothers, Inc.

**DEMPSTER BROTHERS** 5105 Dempster Building, Knoxville 17, Tennessee

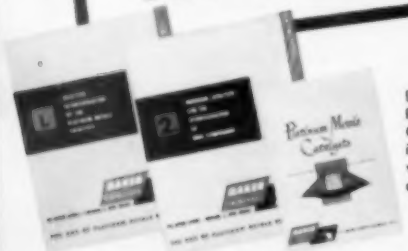
PLATINUM RECOVERY

# COMPLETE FACILITIES FOR PROMPT, EFFICIENT RECOVERY OF PLATINUM METALS FROM SPENT CATALYST

Here, a modern PLATINUM METALS refining plant is provided with special facilities for sampling and recovery from spent catalyst. Baker guarantees 100% return of assayed content.

Our plant is geared to assure dependable service which will free your PLATINUM to manufacture fresh catalyst without unnecessary delay. Baker is also prepared to manufacture fresh catalyst in any required concentration of metal—in the form and on the carrier you specify.

If you would like detailed information on Baker Catalysts and our Catalyst Recovery Service, your inquiry will receive our immediate attention. ★ ★ ★ ★



Literature on Platinum Metals Catalysts is available and will be sent at once, upon request.

**BAKER & COMPANY, INC.**
**CATALYSTS**

113 ASTOR STREET · NEWARK, N. J.

THE HUB OF PLATINUM METALS RESEARCH

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

FIG. 1503 (Sectional)—
150-Pound Steel Gate Valve.

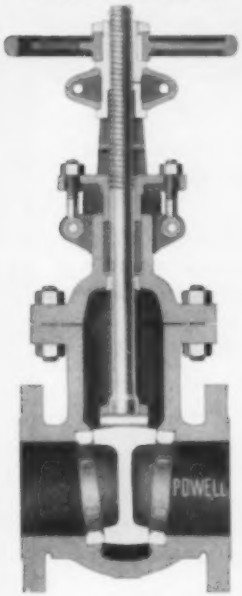


FIG. 2453-G—Stainless
Steel O.S. & Y. Gate Valve
For 150 Pounds.

FIG. 3059-G—300-Pound Steel
Lubricated Plug Valve. Gear Operated

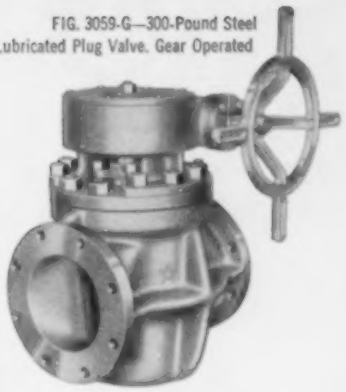


FIG. 3061—300-Pound
Steel Swing Check Valve.

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

# Why Petroleum Engineers Specify Powell Valves . . .

. . . . *because they know Powell Valves are dependable and economical.* Petroleum engineers also know that Powell has *the COMPLETE quality line of valves.*

Investigate the many outstanding features of the Powell Valves shown here . . . as well as *the complete line* of quality valves that have a proven record of long life and dependable service.

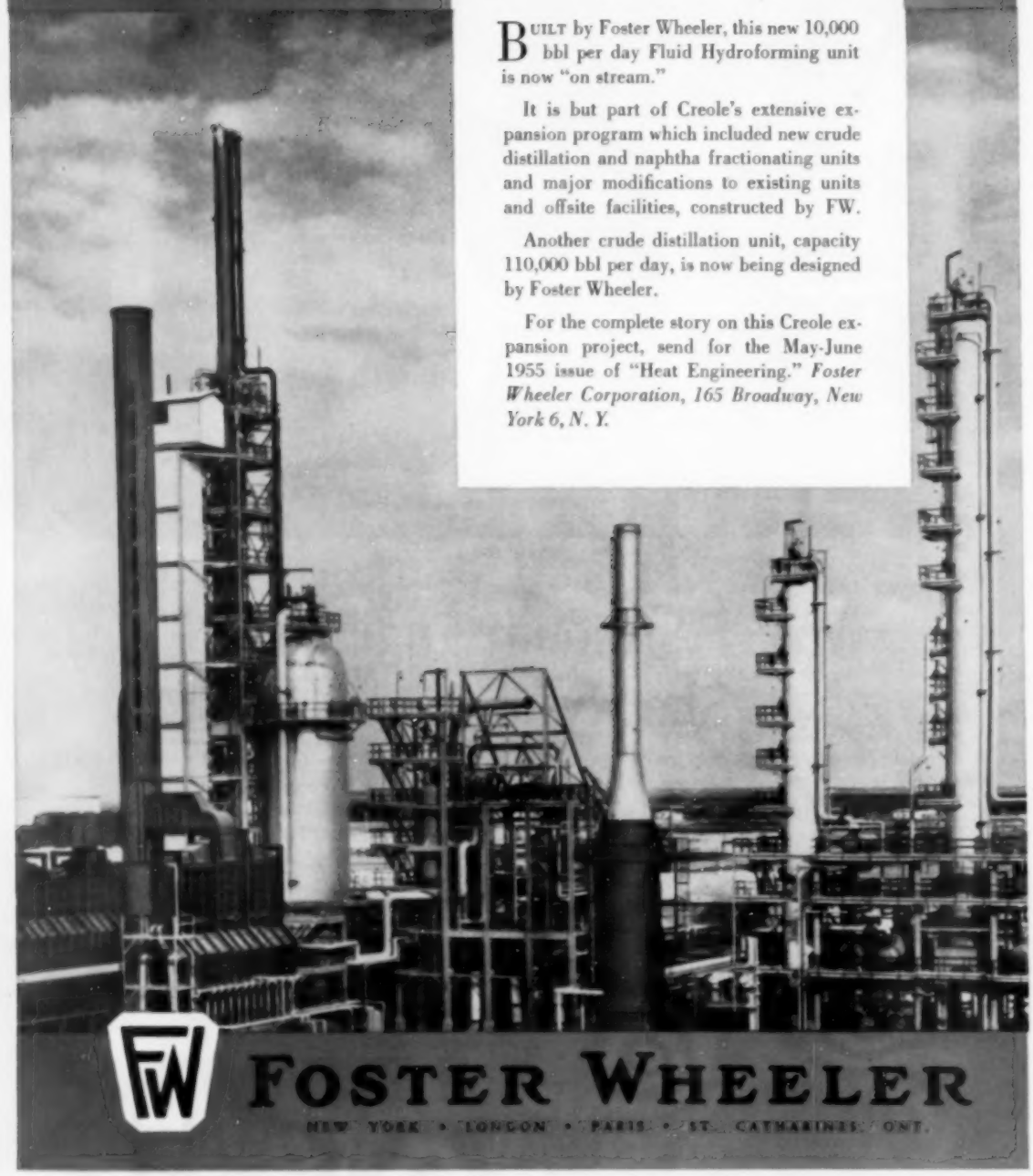
Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have.

**The Wm. Powell Company, Cincinnati 22, Ohio . . . . . 109th year**

# POWELL VALVES

# FLUID HYDROFORMER

## features expansion program at CREOLE'S Amuay Bay Refinery



BUILT by Foster Wheeler, this new 10,000 bbl per day Fluid Hydroforming unit is now "on stream."

It is but part of Creole's extensive expansion program which included new crude distillation and naphtha fractionating units and major modifications to existing units and offsite facilities, constructed by FW.

Another crude distillation unit, capacity 110,000 bbl per day, is now being designed by Foster Wheeler.

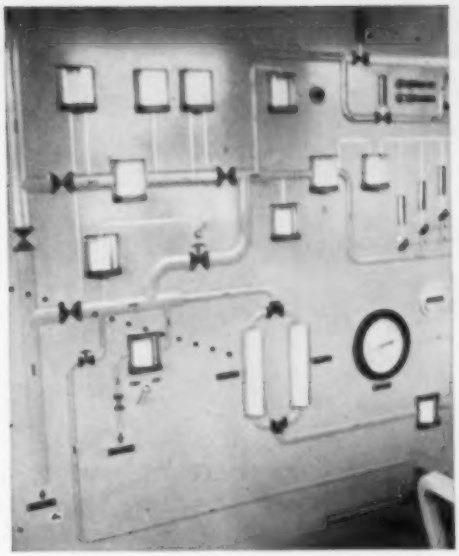
For the complete story on this Creole expansion project, send for the May-June 1955 issue of "Heat Engineering." *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FW

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

# Here's the **Lectrodryer** shown [⬯] on this control board



THIS TWIN-COLUMN SYMBOL on a flow chart or control panel indicates a drier located here in the process, capable of doing a continuous DRYing job. One column does the drying, while the other is being regenerated by heat. To many engineers this symbol means a Lectrodryer*, a member of a large family of driers for air, gases and organic liquids.

Instruments and air-operated valves are kept working smoothly by Lectrodryers which DRY the compressed air fed to them. No freeze-ups where air lines run out-of-doors. No formation of mud or rust to clog delicate instrument ports.

Gas being pumped underground for storage is first dried so there'll be no frosting-up to impede the flow of gas as pressure is dropped to release it to the mains. Materials involved in sensitive reactions in chemical plants, catalytic cracking operations and the like are dried to dewpoints below −110° F. by Lectrodryers.

The book, *Because Moisture Isn't Pink*, pictures many installations. For a free copy, write Pittsburgh Lectrodryer Corporation, 332 32nd Street, Pittsburgh 30, Pennsylvania.

*Large outdoor Lectrodryer DRYing natural gas.*

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

**LECTRODRYER**

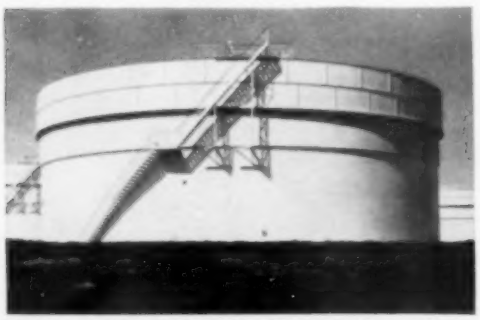
* REGISTERED TRADEMARK U. S. PAT. OFF.

# guard 'gainst evaporation losses

## with GRAVER

## Expansion Roof Tank ©

It is now generally recognized that the Graver Expansion Roof Tank has no peer for protecting volatile liquids from evaporation loss. One such tank often protects an entire terminal. It is easy to manifold to cone roof tankage. The positive liquid seal protects under all conditions. You eliminate breathing losses and minimize filling loss with the Graver Expansion Roof Tank.



GRAVER EXPANSION ROOF TANKS give long, trouble-free service. After 16 years, the first tanks of this design are still operating effectively—and with only normal attention and maintenance.

**GRAVER TANK & MFG. CO., INC.**

**East Chicago, Indiana**

CHICAGO • NEW YORK • PHILADELPHIA • EDGE MOOR, DEL. • CATASAUQUA, PA. • PITTSBURGH • CLEVELAND • DETROIT • TULSA • SAND SPRINGS, OKLA. • HOUSTON • ODESSA, TEXAS • CASPER, WYO. • LOS ANGELES FONTANA, CAL. • SAN FRANCISCO

**GRAVER** ®... **CONSERVATION TANKAGE FOR THE PETROLEUM AND CHEMICAL INDUSTRIES**

# background of champions . . . . BRICK

The stands may be steel, the walls concrete, but there'd be no World's Series crowd like this were it not for brick, and you'd have no money to pay for a seat.

Brick—refractory brick—is the fundamental and universal material of industry. It stands at the beginning of manufacturing, power, transportation . . . everything that's made or moved.

Meeting these needs, with the infinite variety of their requirements, calls for massive production facilities. But even more important, it calls for the application of the most advanced and intricate physical sciences.

The first we provide with plants located from coast to coast. The latter with the world's largest and most modern refractories research laboratory.

GENERAL REFRACTORIES COMPANY
Philadelphia 2

## A COMPLETE REFRACTORIES SERVICE FOR THE PETROLEUM INDUSTRY

To maintain quality in castables, plastics, mortars, brick and the many other refractory products required by the Petroleum Industry requires just such an organization as GREFCO. First of all, proper formulation and manufacturing procedures must be developed. For this a modern laboratory with many kinds and types of modern equipment is necessary. Also experienced technicians are essential. GREFCO has the largest and most modern well equipped refractory laboratory in the world well staffed with trained and experienced technicians. A product developed by the GREFCO central research laboratory can be depended upon as being an outstanding quality product. Also, published data on products can be depended on to be accurate and reliable. No guesswork.

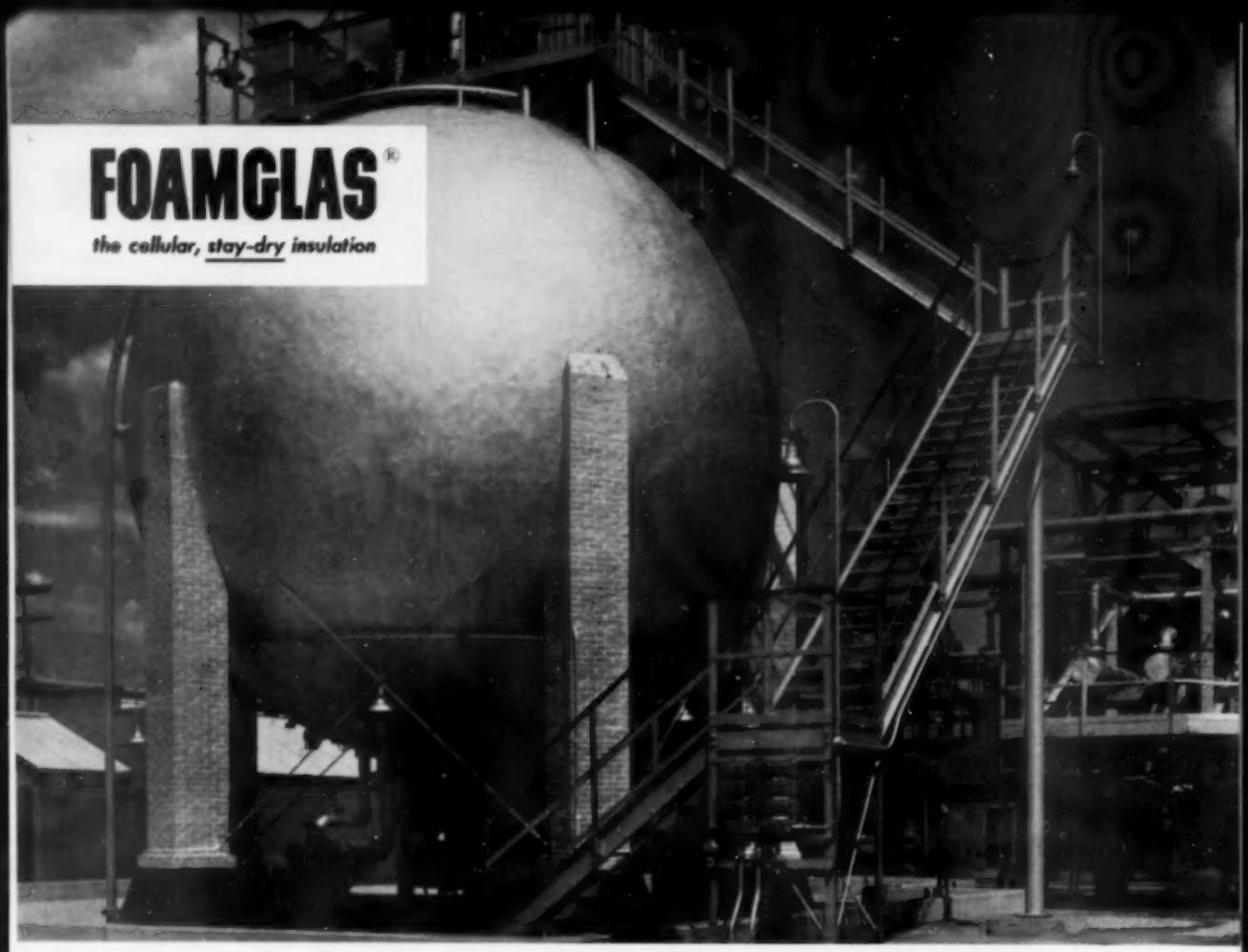
Modern manufacturing facilities and absolute control of raw materials are a second must for quality products. Here again GREFCO excels and has not one, two, or three manufacturing units but 26 strategically located modern works with plant or district laboratories staffed with experienced ceramic engineers who constantly check and test raw materials and production.

Why take the chance of shutting down equipment because of failure of a refractory lining. Don't let the cut price of the wood shed operation tempt you. Specify GREFCO and be assured of quality and uninterrupted service.

GENERAL REFRACTORIES

# FOAMGLAS®

*the cellular, stay-dry insulation*



Insulation Contractor: Combustion Equipment & Insulation Co., Cleveland, Ohio

SOHIO gets efficient desalting because . . .

## Spillage-proof FOAMGLAS insulation stays effective to hold precise temperature

Efficient electric desalting to remove salts and other impurities from crude charging stocks demands precise temperature control throughout the process. The influent temperature (180° F to 220° F depending on viscosity of crude) must be held constant until effluence. Since there's no exchange of heat inside the sphere, it must be insulated very effectively.

For six years Standard Oil Company (Ohio) has maintained peak desalting efficiency by insulating their spheres in Cleveland, Lima and Toledo with FOAMGLAS. This unique cellular glass insulation benefits SOHIO three ways:

1. **Spillage-proof,** moisture-proof FOAMGLAS retains its insulating value . . . avoids fire hazard.
2. **Easy-to-apply** FOAMGLAS blocks are lightweight but very strong, readily applied to sphere, eliminating insulation supports.
3. **Effective insulation** holds temperature required for electric field to break continuously the water and oil emulsion. It also prevents temperature drop near vessel wall . . . avoids thermal currents which would interfere with process.

You'll benefit too by using this unique insulation. For more facts please write for booklets on FOAMGLAS for piping or tanks and equipment.

Pittsburgh Corning Corporation

Dept. PP-105, One Gateway Center
Pittsburgh 22, Pennsylvania

In Canada: 57 Bloor St. W., Toronto, Ontario

**Visit our booth at the CHEMICAL SHOW, Philadelphia, December 5th to 9th**

2" thick FOAMGLAS blocks cut to 12 x 12 size were laid diamond shape on SOHIO'S desalter sphere in Toledo. Two Nelson studs were welded through each block and secured with recessed Tinnerman speed clips. After asphalt cutback (Insulmastic 4010)—glass fabric—cutback application, the surface was finished with an asphalt base aluminum paint.

**STANDARDIZE ON THIS FITTING AND YOU'LL REDUCE INVENTORY...SAVE MONEY...**

# it's the NEW 5000 TYPE KEY® RETURN BEND FITTING

**WITH HIGH DEGREE OF INTERCHANGEABILITY**

**TWO SERIES:**
**850 and 1275 LBS.**
**NINE FITTINGS**
**in each series**

A TOTAL OF 18 FITTINGS, BUT REQUIRING ONLY 26 PARTS INSTEAD OF 72

**HEADING UP OPERATION**
Holding member and screw may be handled as a unit.

**UNHEADING**
A slight loosening of the screw permits holding member and screw to be removed as a unit. The stem has been designed to withstand plug removal by striking with a hammer.

**SAFETY FEATURE**
Plug can be loosened before a holding member is disengaged, preventing the possibility of the plug blowing out of fitting as the result of build up of back pressure.

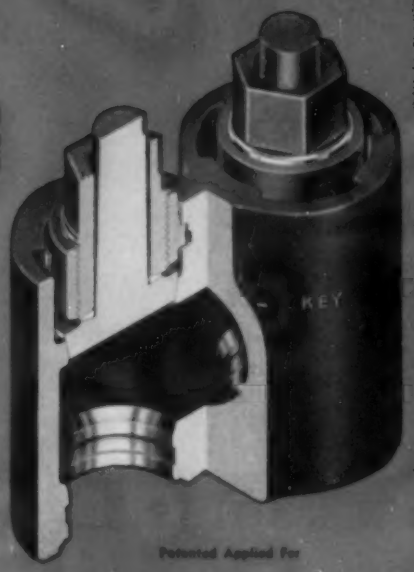
**DAMAGED PARTS**
If threads become damaged or frozen, holding mechanism can be removed by turning the breech.

**STRESS DISTRIBUTION**
Elliptical crossovers in the 5000-type give a maximum uniform distribution of stress. Plug hole section will be more uniformly stressed because of the added support of the 360° projection immediately abbve the plug seat.

**METAL IN TENSION**
The tension load is evenly distributed throughout the 360° circular projection.

**SHEAR**
The shear load is evenly distributed over 180°.

**BENDING**
No bending can occur in the holding member and the full 360° projection above the plug seat prevents bending of the lugs.




Patented Applied For

**850 lb. and 1275 lb. series**

| Fitting Size | Plug Number | Holding Member Number | Screw Number | Thrust Ring Number |
|---|---|---|---|---|
| 2½ | 8Y1 | 2Y1 | 9Y1 | D-13011 |
| 3 | 8Y2 | 2Y2 | 9Y2 | D-13012 |
| 3½ | 8Y3 | 2Y3 | | |
| 4 | 8Y4 | 2Y4 | | |
| 4½ | 8Y5 | 2Y5 | 9Y3 | D-13013 |
| 5 | 8Y6 | 2Y6 | | |
| 5½ | 8Y7 | 2Y7 | | |
| 6 | 8Y8 | 2Y8 | 9Y4 | D-9356 |
| 6½ | 8Y9 | 2Y9 | | |

**All parts of the 5000-type fitting, exclusive of the body casting, are available for immediate shipment from stock.**

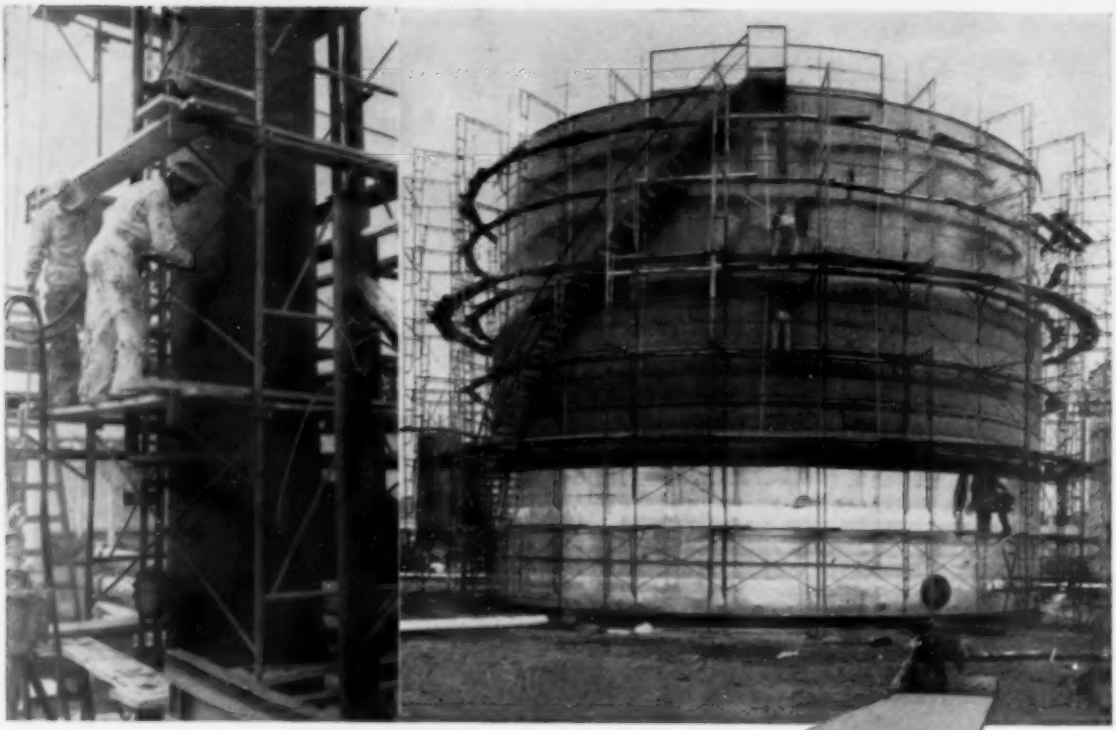
**Write for information and prices now**

key company

*Since 1916 . . . manufacturers and developers of product[illegible] for high temperatures and pressures*

P.O. BOX [illegible] EAST ST. LOUIS, ILLINOIS

DISTRICT OFFICES: [illegible]
CHICAGO • [illegible]



# Two new techniques revolutionize the insulation of tanks, vats and vessels...

. . . and both of these new low-cost methods involve the use of ULTRALITE*, the long fine glass fiber insulation.

For large storage tanks, the most economical method is to cut long strips of ULTRALITE, run them around the tank (or from top to bottom) and cover with metal jacketing. On smaller vessels, like the fractionating column pictured, the common practice is to wrap with ULTRALITE, apply a mesh screen, and spray with weatherproofing materials.

Either of these ULTRALITE methods requires only a fraction of the time that would be spent in cutting, fitting and applying rigid segmental blocks or bats. Once applied, there will be no cracking of the insulation when expansion and contraction take place, for ULTRALITE is flexible and resilient. Best of all, your insulation is permanent, for ULTRALITE is as enduring as glass itself.

Like to receive complete details on these methods that will save you a good deal of time and money on that next insulating job? Just write today—or better yet, call your local ULTRALITE distributor in any of 57 cities. You'll find him listed in the Yellow Pages under "Gustin-Bacon Insulations."

*Reg. U.S. Pat. Off.

**GUSTIN-BACON** *Manufacturing Company* GUSTIN gb BACON

Thermal and acoustical glass fiber insulations • Pipe Coverings and fittings • Railroad gaskets and supplies

**268 W. 10th St., Kansas City, Mo.**

# THE MOST POWERFUL GASOLINE LOSES ITS POWER WITHOUT THESE ADDITIVES

# Tenamene

**EASTMAN GASOLINE ADDITIVES**

Protecting the performance of gasoline are the gum-inhibiting Tenamenes. Protecting the performance of the Tenamenes are the care in manufacture and the interested technical service of our petroleum specialists who are ready to help solve your refinery inhibitor problems on the spot.

*For more information on Tenamene additives and the service that backs up their proper use, contact our local representative or write to Eastman Chemical Products, Inc., Kingsport, Tennessee—a subsidiary of Eastman Kodak Company.*

**SALES OFFICES: Eastman Chemical Products, Inc.,** Kingsport, Tennessee; New York—260 Madison Ave.; Framingham, Mass.—65 Concord St.; Cincinnati—Carew Tower; Cleveland—Terminal Tower Bldg.; Chicago—360 N. Michigan Ave.; St. Louis—Continental Bldg.; Houston—412 Main St. **West Coast: Wilson Meyer Co.,** San Francisco—333 Montgomery St.; Los Angeles—4800 District Blvd.; Portland—520 S. W. Sixth Ave.; Salt Lake City—73 S. Main St.; Seattle—821 Second Ave.

# HOW TO GET THE BEST RESULTS FROM ANY TRAPPING JOB...

## DRAINING CONDENSATE FROM STEAM

How to correctly size, install and maintain steam traps for any pressure, any temperature, any load... Armstrong inverted bucket trap design principles and advantages... sizes, list prices, physical data, capacities... data on variable loads, warming-up loads, submerged coil heat transfer, steam main and riser drainage... trapping of unit heaters... power plant trapping, and many other subjects. ASK FOR 44-PAGE CATALOG J, The Armstrong Steam Trap Book.

## DRAINING LIQUIDS FROM AIR AND GAS

How to select and install ball float traps for draining light liquids or water from drip points, aftercoolers, separators, etc., in compressed gas and air systems... liquid level control hookups... high pressure trapping to 1000 psig... trap materials for corrosive service... capacities, physical data, list prices, single lever, compound lever and "snap-action" traps. ASK FOR BULLETIN 289.

## VENTING AIR AND GAS FROM LIQUIDS

Selection and installation of ball float traps for venting air and gas from water and light liquids under pressure... contains useful table on air discharge through various size orifices at pressures from 1 to 1000 lbs.... when and how to back vent traps... floats and mechanisms for other manufacturer's devices... sizes, list prices, materials, dimensional data for Armstrong Ball Float AR Traps. ASK FOR BULLETIN 450.

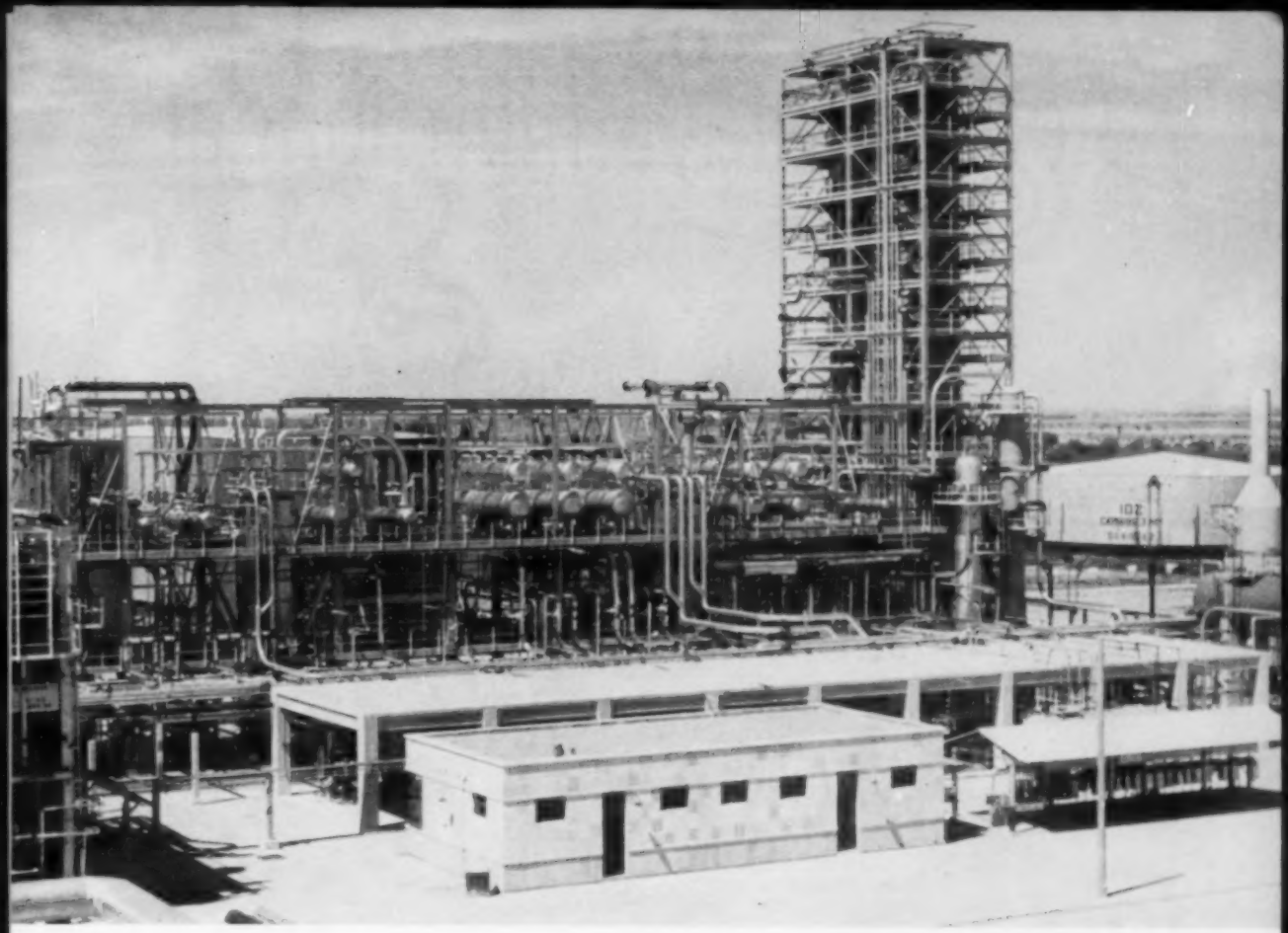
## DRAINING WATER FROM LIGHT LIQUIDS

Dual gravity trap selection and installation explained and diagramed... for draining gasoline separators, dehydrator tanks, debutanizers, etc.... orifice capacity data, dimensions, materials, list prices for Armstrong Ball Float D/G Traps. ASK FOR BULLETIN 2091.

**Free on request without obligation—call your local Armstrong Representative, or write Armstrong Machine Works, 826 Maple Street, Three Rivers, Michigan**

# ARMSTRONG

**INVERTED BUCKET and BALL FLOAT TRAPS FOR THE PETROLEUM INDUSTRY**



*From plant site to producing plant . . .*

## McKEE ASSURES YOU SOUND ENGINEERING OF EVERY DETAIL OF YOUR NEW PROJECT

● McKee brings to your project a fifty-year background of specialized experience in the design and construction of some of the most complex types of production facilities in use today. But, equally important to you, is the high *quality* of McKee engineering—the meticulous care given to every detail—from studies for selection of the site to completion of the plant ready for operation.

It's this high *quality* of painstaking engineering by McKee that results not only in correct design and efficient layout, but in reduced construction man-hours and most advantageous use of materials. That's why top men in the world-wide industries we serve will tell you "*McKee is the best name you can get*" on the engineering of your new plant.

50th ANNIVERSARY

**McKee Engineering Services**

**Arthur G. McKee & Company • Engineers and Contractors**

*Headquarters:* McKee Building • 2300 Chester Avenue • Cleveland 1, Ohio
*Offices:* New York, N. Y. • Union, New Jersey • Washington, D. C.
*British Representatives of Metals Division:* Head, Wrightson & Co., Limited
*Canada:* Arthur G. McKee & Company of Canada, Ltd., 372 Bay St., Toronto

# Activity stays high longer

# Aerocat®

## fluid cracking catalyst

## Balanced with HI PV*

New higher pore volume in AEROCAT Fluid Cracking Catalyst is the key to its exceptional thermal and steam stability.

By increasing pore volume, Cyanamid has endowed this catalyst with activity that stays high longer in steam atmospheres and at high temperatures. High pore volume is carefully balanced with pore diameter and specific surface to achieve the ultimate in activity maintenance without sacrificing other desirable characteristics.

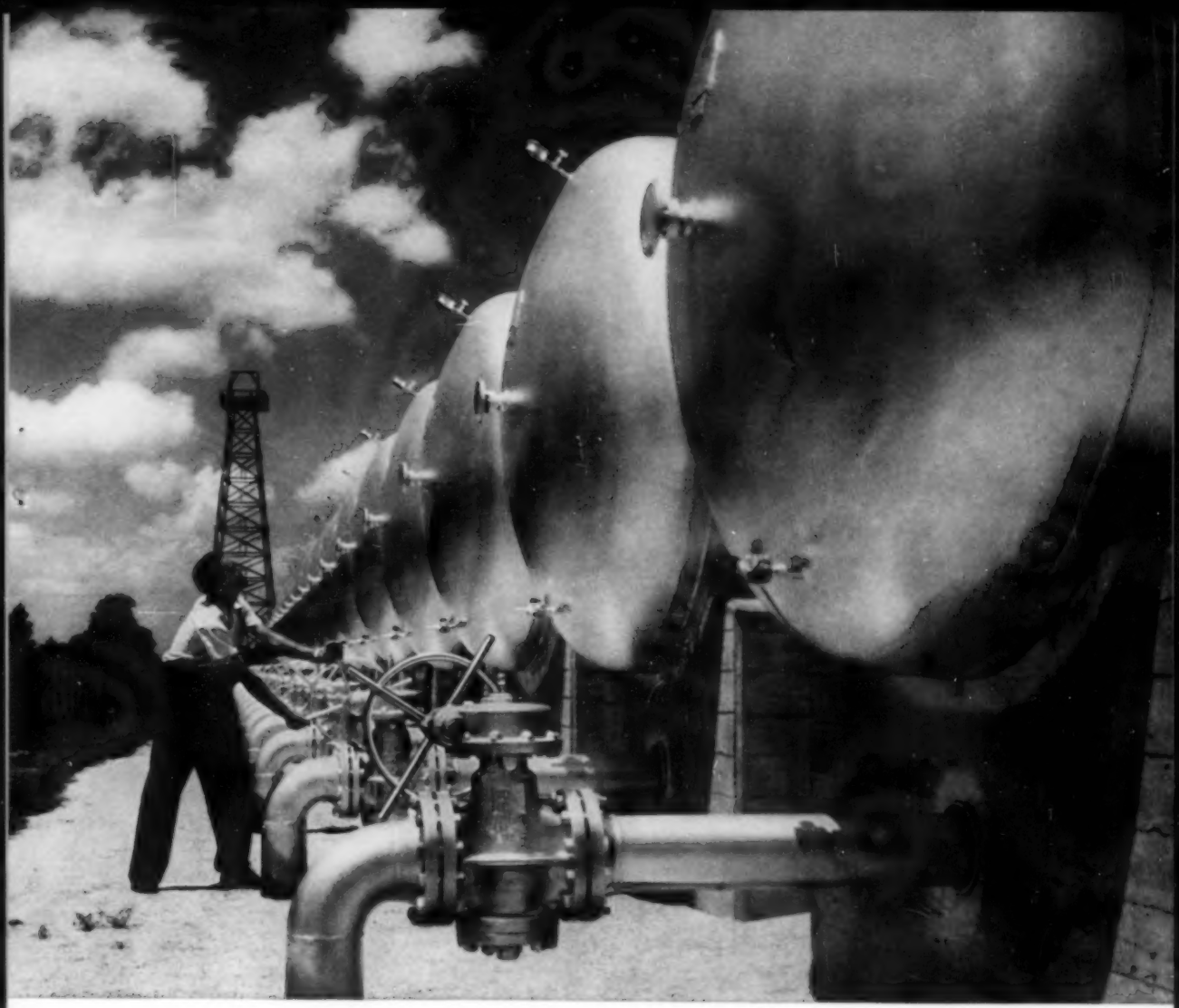
Cyanamid has pioneered this improved catalyst to boost cracking efficiency. Its superior performance is now backed by extensive commercial experience.

Ask your Cyanamid representative about HI PV and the contribution new AEROCAT Catalysts can make to your cracking operations.

*Trade-mark

AMERICAN *Cyanamid* COMPANY
REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal



# Leak Proof

Sooner or later, ordinary valves leak because they depend solely upon uncertain metal - to - metal seating. Rockwell - Nordstrom valves are leak proof because the unique Sealdport* lubrication system surrounds the plug and body with a positive seal of pressurized lubricant. This penny's worth of prevention saves countless dollars in lost product, maintenance, and down-time.

Rockwell-Nordstrom, *the original lubricated plug valve*, has set outstanding performance records for forty years. Why not specify the valve and lubricant combination that has *proved* its dependability and economy. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

*a registered trademark of Rockwell Manufacturing Company

## ROCKWELL-Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF

## Lubricant Seating Controls Abrasive Slurries

Slurries and entrained solids raise havoc with ordinary valves. Erosion and corrosion soon cut into vital seating areas and ruin the metal-to-metal closure. This can't happen in Rockwell-Nordstrom valves because the seal is a constantly renewed film of tough lubricant under pressure. Seating areas are *never* exposed. And there are no pockets or cavities in the Nordstrom valve to collect deposits that ruin other valves.

The Rockwell-Nordstrom combination of the right valve and the right lubricant for every slurry service will give you a more dependable operation—at lower yearly cost—than any other valve you've ever used. Write today for full information. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF

# Consider QO® Furfural's

## fine Record of Stability in Refining Operations

Under conditions encountered in petroleum refining, QO Furfural has a high degree of stability. This stability is well demonstrated by long continuous operation and by the low solvent losses in operating units.

Furfural losses reported by the various lube refining units run as low as 1/100% of the furfural cycled. In another somewhat similar operation, extractive distillation of butadiene, furfural losses are reported to be between 1/100 and 2/100% of the total circulated.

Recently it was reported (Petroleum Refiner *34*, #3, 138 [1955]) that one furfural lube refining unit made a run of 27 months duration. This unit is now on an 18-month turnaround schedule. Solvent stability makes possible this fine record.

**Send for our new Bulletin 203-A which describes the Physical Properties of QO Furfural.**

**The Quaker Oats Company** — **CHEMICALS DEPT.**

339X The Merchandise Mart, Chicago 54, Illinois
Room 539X, 120 Wall St., New York 5, N. Y.
Room 439X, 3000 N. Going St., Portland 11, Oregon

In the United Kingdom: Imperial Chemical Industries Ltd., Billingham, England
In Europe: Quaker Oats Graanproducten N. V., Rotterdam, The Netherlands; Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France; A/S "Ota", Copenhagen, S. Denmark
In Australia: Swift & Company, Pty., Ltd., Sydney • In Japan: F. Kanematsu & Company Ltd., Tokyo

# WHEN YOU'RE UNDER PRESSURE

## ON PRESSURE VESSELS . . .

# THIS IS THE KIND OF HELP YOU GET AT KELLOGG . . .

**Design Engineering:** Kellogg will assume entire responsibility or work closely with your own design engineers on their proposals. Optimum designs are assured either way.

**Technical Competence:** Kellogg's experience in metallurgy, heat transfer, stress analysis, metal fatigue, corrosion control, is unequalled among pressure vessel fabricators.

**Fabricating Techniques:** Kellogg fabrication methods are the culmination of 40 years of building pressure vessels to exacting specifications. Many improved techniques have resulted, such as K-Weld*.

**Non-Destructive Testing:** Kellogg's complete facilities include the company's portable "atomic cameras" which can photograph welded seams up to six inches thick in a single short exposure.

**Prompt Delivery:** Kellogg's plant modernization program assures faster delivery than ever before. Small and large orders receive the same attention.

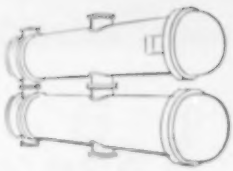
**Construction Service:** Kellogg's continuing work in erecting vessels for complete oil refineries, pulp mills, and chemical plants provides a fully-staffed construction department with crews that know their jobs.

**Guaranteed Performance:** Kellogg's reputation has been built on long and efficient product life. The MWK name plate is your guarantee.

**FABRICATED PRODUCTS DIVISION**
**THE M. W. KELLOGG COMPANY, 225 BROADWAY, NEW YORK 7, N. Y.**
*In Canada: The Canadian Kellogg Company, Limited, Toronto*
*In Europe: Kellogg International Corporation, London*
SUBSIDIARIES OF PULLMAN INCORPORATED

*Trademark of The M. W. Kellogg Company

**PUT YOUR PROBLEMS UP TO** M KELLOGG W



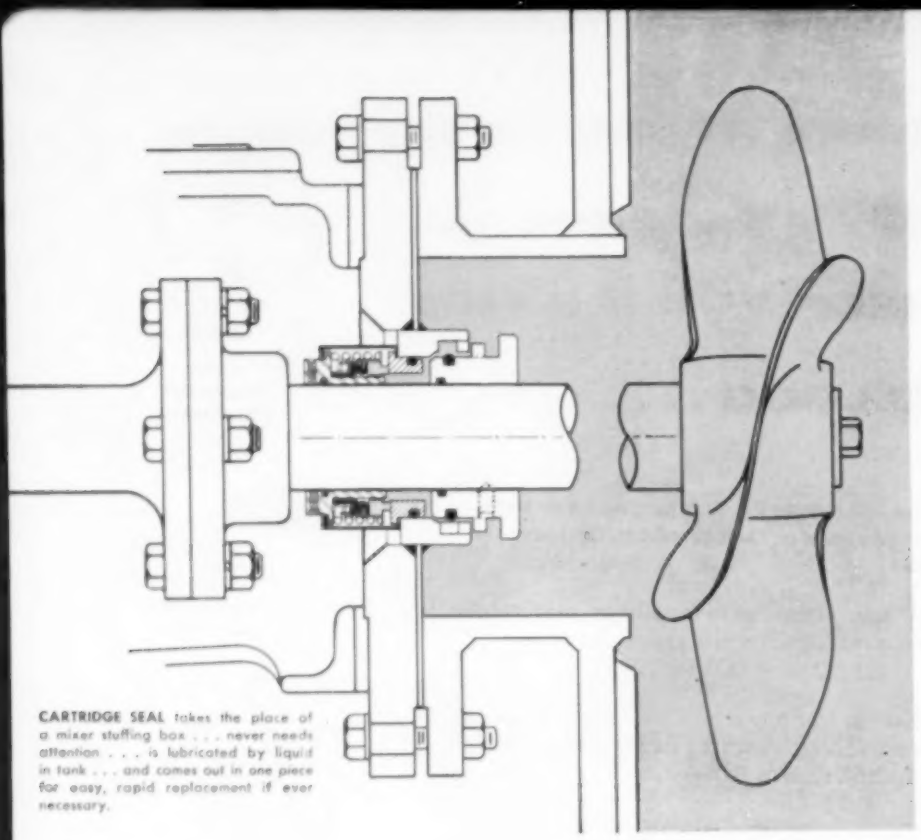
HEAT TRANSFER EQUIPMENT

TANKS AND REACTORS

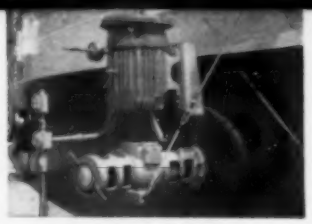
KNOCKDOWN VESSELS

PROCESS PIPING

PRESSURE VESSELS

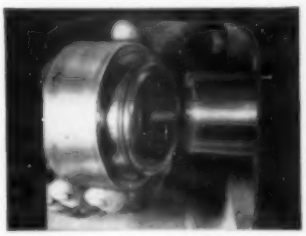


**CARTRIDGE SEAL** takes the place of a mixer stuffing box . . . never needs attention . . . is lubricated by liquid in tank . . . and comes out in one piece for easy, rapid replacement if ever necessary.



**YOU HARDLY EVER** need to change a LIGHTNIN Seal. But if you do, it's simple—even with the tank full. Mixer remains on the tank . . .

**MIXER SHUTOFF** closes like a valve to keep liquid in the tank while seal is being changed. No need to drain the tank.



**CARTRIDGE SEAL** slides off shaft, which uncouples to permit removal. New seal cartridge goes in its place. Taper on shaft insures correct alignment when recoupling.

# *Mix fluids in big tanks*
# **at lower cost than ever before**
# *with new quick-change rotary seal*

What do you spend yearly to maintain the stuffing boxes on your side entering mixers?

That's a rough measure of what you can *save* by using LIGHTNIN Mixers equipped with new LIGHTNIN cartridge-type rotary mechanical seals.

Here's why you can begin right now to revolutionize your maintenance picture with this amazing new mixer seal:

1. You eliminate "nursing" and periodic repacking of mixer stuffing boxes. The LIGHTNIN Seal gives leakproof operation—for *years*, under most conditions—*without attention of any kind.*
2. *You can replace* a LIGHTNIN Seal whenever necessary—*in minutes.* Without draining the tank. Without dismantling or demounting the mixer. And *without special skill.*

You can get LIGHTNIN Seals now on all LIGHTNIN Mixers. You can get quick delivery from stock, any time, on a wide range of seal types, in materials to suit your conditions.

Already, oil companies using LIGHTNIN Seals report maintenance savings running into many thousands of dollars yearly.

Your LIGHTNIN Mixer representative can give you the full story—show you how much *you* can save. Call him today. You'll find his name in your copy of Refinery Catalog. Or get the facts by mail: Send the coupon for 8-page, fully illustrated Bulletin B-111.

***Get the cost-cutting facts now...*** New 8-page Bulletin B-111 shows how you get maintenance-free sealing that really slashes fluid mixing cost to a new low. Send also for LIGHTNIN Mixer catalogs listed here. Free—no obligation. Just check data you want, tear out and mail to us today with your name and company address.

- ☐ B-111 LIGHTNIN Rotary Mechanical Seals
- ☐ DH-50 and DH-51 Laboratory Mixers
- ☐ B-102 Top Entering Mixers (turbine and paddle types)
- ☐ B-103 Top Entering Mixers (propeller types)
- ☐ B-104 Side Entering Mixers
- ☐ B-107 Mixing Data Sheet
- ☐ B-108 Portable Mixers (electric and air driven)
- ☐ B-110 Condensed Catalog (complete line)

**MIXING EQUIPMENT Co., Inc.,** 131-k Mt. Read Blvd., Rochester 11, N. Y.
*In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 10, Ont.*

**Lightnin® Mixers™**

**MIXCO fluid mixing specialists**

Petroleum Processing

OCTOBER 1955

# What About Gas Turbines?

*Here's a rundown on fuel and lubricant needs for aviation, industrial, and automotive uses*

TODAY'S growing use of the gas turbine engine, with its radically different fuel and lubricant requirements, may have a profound effect on long range refinery planning.

In fact, in certain instances the formulation of improved fuels and oils has been an important complement to the development of higher powered engines which operate at high severity levels.

The advantageously high power-to-weight ratios obtainable with the gas turbine have led to its exploitation as a prime mover in a wide range of applications.

**Two are here right now.**

- **In aviation**—all advanced design military aircraft are now being equipped with gas turbine engines, either turbojet or turboprop type. Furthermore, the turboprop has already been hailed as a strong competitor to the well-established piston engine in the commercial aviation field.
- **In industry and railroading**—perhaps not so highly publicized, but of considerable significance nonetheless, is the successful utilization of gas turbines to drive locomotives, compressors, generators, pumps, blowers, etc.

**The third is just ahead.**

- **In automotive equipment**—the gas turbine is being intensively evaluated for possible use in passenger cars, trucks, and other road vehicles.

Basic design is very similar for the various gas turbines—industrial, aviation, and automotive. Each contains an air compressor, a combustor section, and a turbine wheel. A certain amount of the energy in the exhaust gases generated by combustion has to be used to drive the compressor. The remaining energy is available as source of rotary power—except in aviation installations where it may also provide thrust (turboprop) or only provide thrust (turbojet).

**Fuel and lube needs vary.** Each individual turbine type has its own particular idiosyncrasies as dictated by economics, logistics, climactic environment, or level of operating severity. In certain applications, the currently available fuels and oils will not perform satisfactorily at all. New and improved classes of materials are required.

## Aviation Fuels

The JP-4, a 2 to 3 psi. RVP fuel similar to heavy gasoline fractions, has been the chief operational fuel of the military. Older type jet engines have performed very satisfactorily on this material. These same powerplants could also be operated on low viscosity, low pour-point mineral oils as covered by specification MIL-O-6081-A, grade 1010 or 1005.

**Petroleum processors face** a number of difficult problems, however—as do the engine builders and airframe designers—with the development of the turbine engine for supersonic flight. The new engines feature higher compression ratios with increased power output-to-weight ratios.

These factors, coupled with ram temperature rise at supersonic speeds, have tended to raise materially the temperature prevailing in the engine and aircraft. These temperatures have reached—in the more advanced engine designs—the point where new and improved fuels and lubricants are needed to replace the conventional types mentioned above.

Less volatile, or kerosene-type, fuels will have to be employed in the newer jet aircraft, rather than JP-4. Kerosenes possess higher heat content per unit volume, and jet aircraft will be mostly volume rather than weight limited. Moreover, use of more volatile JP-4 stocks could lead to build-up of excessive pressures in the fuel tanks of planes operating at the high temperatures of supersonic flight.

Other problems may be encountered in the form of burning quality, carbon forming tendencies, and low temperature properties (freezing points). However, it is believed these difficulties can be readily overcome.

**The major fuel quality problem** of the future is thermal stability, one which will require a great deal of investigation. It is a necessity in order to maintain fuel flow. Thermally unstable fuels such as those currently being produced, undergo degradation under high temperature conditions. This is manifested by the formation of insoluble sediment which clogs fuel lines and causes critical reductions in fuel flow.

Fuel is being looked to as a solution to the problem of heat removal from engine and aircraft in many types of jet planes, from the lubricating oil and such components as radar, hydraulic systems, and air conditioning equipment. Air coolers are not practicable because they impose severe drag penalties and because the boundary air is heated by friction and compression. In principle, fuel as a coolant would appear to be a convenient solu-

**Table 1—Properties of Ester-Type Synthetic Lubes**

| | U.S. Type* | U.K. Type** |
|---|---|---|
| Viscosity @ 210° F., cs | 3.6 | 7.8 |
| @ −40° F., cs | — | 12,500 |
| @ −65° F., cs | 12,500 | — |
| Pour point, ° F. | <−75 | −65 |
| Flash point, ° F. | 430 | 450 |
| Load carrying capacity (Relative) | 60 | 100 |

* Conforms to MIL-L-7808.
** Conforms to Ministry of Supply Spec. DERD-2487

tion. However, in practice, it undergoes the degradation discussed previously.

**Two approaches are possible** for minimizing thermal stability. One is through engine and/or aircraft design. However, the introduction of extraneous cooling and insulating systems bears with it severe weight penalties and results in impaired aircraft performance.

**A second solution is in the fuel** itself. Fuel suppliers have three possible means for improving stability.

1—Segregation of stable stocks.

2—Use of processing or treating techniques to improve stability.

3—Incorporation of additives.

**Segregating stable stocks:** Full-scale mock-up fuel system evaluations carried out by a major engine builder have demonstrated that certain kerosene stocks — available nationally — have an adequate level of thermal stability. The tests also showed that equally stable, or better, fuels can be prepared by severe acid treating and by alkylation.

None of these techniques could produce the enormous quantities of jet fuels which would be needed in a national emergency. However, limited amounts of stable stocks could be segregated for the most critical engines and planes if such a situation were to develop overnight.

**Use of process techniques:** Experimental work, not yet completed, has revealed one possible means of producing the high quality fuels on a large scale. Hydrotreating of unstable stocks has been found to produce a marked improvement in quality, and it is being closely investigated. If this approach continues to show promise, it will be of particular importance because of the large amount of hydrotreating capacity being installed by U. S. refiners.

**Additives:** A number of addition agents have been developed with promise as a solution to thermal stability problems, used either alone or in combination with processing techniques. This route must be approached with caution, because these materials could introduce new problems such as emulsions, altitude foaming, or restriction of low temperature flow.

## Aviation Lubes

Temperature conditions represent the main factor in the problem of providing satisfactory lubrication for advanced engine design. At the bearing temperatures of 500 to 550° F., mineral oils tend to volatilize excessively, depositing injurious residues. Engine operation on these lubes is definitely unsatisfactory.

**Synthetic lubricants are now** being employed in all advanced design engines in both the U.S. and United Kingdom. Performance of these ester-based oils has been generally satisfactory. It has been much improved over that afforded by the low viscosity petroleum oils in terms of better load carrying capacity, lower consumption, and reduced deposit forming characteristics.

**Properties of the materials** conforming to U.S. and U.K. specifications are shown in Table 1. Chief difference is that the British require pumpability and operability down to −40° F. and the U.S. requires fluidity down to −65° F.

**These are still short of the goal** however. For further improvement in performance, engine builders would like to increase the amount of heat rejected to the oil.

The preferred technique for accomplishing this would be by raising the overall bulk oil temperature, because installing additional oil cooling equipment in a plane again imposes the penalties of weight and performance. Unfortunately, with the existing available materials, no significant increases in operating temperature can be tolerated. The limitation—like that with the fuels—is deposit forming characteristics.

**The need then is for lube oils** with improved high temperature stability and reduced coking tendencies. Certain other properties in the lube oil could also be used to considerable advantage by engine builders. For example, high load carrying capacity products are needed for the critical turboprop engines.

Up to now the synthetic lubricants approved for use in this country and Great Britain have been based principally on chemicals of non-petroleum origin. Development has been lacking in obtaining better lubes from petroleum derived raw materials. The utilization of the potentially more widely available petroleum chemicals would have considerable importance in the event of an all-out emergency requiring large volumes of lubes.

## Industry & Railroad Fuels

High power output from relatively small size and weight in the gas turbine engine, a big factor in aviation usage, has also led to increased popularity for the turbine in industry and railroads. Installations include locomotives, pipeline pumping service, electric power generation, and oil field repressuring.

**Competition here is with** well established power generators—the diesel engine and the steam turbine. Widespread application of gas turbines depends on their ability to consume the cheapest available liquid fuels. They will have to counterbalance the higher efficiency of the diesel and avoid fuels

## NPA Holds Gas Turbine Symposium

A SYMPOSIUM on gas turbine fuels and lubricants highlighted the 53rd annual meeting of the National Petroleum Association in Atlantic City, Sept. 14-16 at the Hotel Traymore. Papers on the subject were presented by authorities from five industries and the U. S. Navy:

"Gas Turbines—Their Fuels and Lubricants," A. B. Crampton, and H. F. Corning, Esso Research and Engineering Co.

"Fuels for Navy Gas Turbines," Harry F. King, head, fuels and lubricants branch, Bureau of Ships, Department of the Navy.

"Residual Fuels for Gas-Turbine Use," C. M. Gardiner, supervisor of combustion, gas-turbine engineering, General Electric Co.

"General Fuel Requirements for the Commercial Aircraft Gas-Turbine," M. C. Hardin and F. G. Dougherty, Allison division, General Motors Corp.

"Turbos for Vehicles," Andrew A. Kucher, director, scientific laboratories, Ford Motor Co.

"Fuels and Lubricants for Gas Turbine Locomotives," F. Fahland, general mechanical engineer, Union Pacific Railroad Co.

The articles on these pages relating to this subject are all based upon the information in the above papers.

more expensive than those used for steam turbines.

In essence, the gas turbine must be operable on Bunker C, in many areas the only economical fuel. The main objectionable feature of Bunker C is its ash content.

**Other fuels which may be used** include natural gas, heating oil, and catalytic cycle stock. Natural gas is ideal because of its rapid burning, non-luminous flame. However, economics permit its use only in gas-producing areas or along gas pipelines. At present, natural gas units account for the majority of gas turbines installed in the Western Hemisphere.

Heating oil and catalytic cycle stock contain little or no ash, but heating oil costs 4 to 5¢/gal. more than does Bunker C, and the premium for cycle stocks approaches this figure. Preliminary studies on supplying a low cost, ash free, residual indicate, in specific cases studied, that cost of distribution nullified the low refinery price.

**Bunker C is noted for** its variation in type and quantity of trace contaminants, whose presence depends mainly on crude source and refinery processing. The ash content can be very critical on turbine operation. Small fractions of the ash may deposit and tend to choke the gas turbine, reducing volumetric efficiency. Moreover, vanadium and sodium, two common ash components, cause severe corrosion of the super alloys in the high temperatures prevailing in gas turbines. Typical analyses for fuel oils from various crude sources are shown in Table 2.

Besides the metals, sulfur in Bunker C also has a significant effect. It contributes to deposits by forming sulfates. The other metals such as iron, nickel, calcium, and magnesium are not considered harmful from the corrosion standpoint, although they may of course form deposits.

**There are four routes** to making residual fuel suitable for gas turbines:

1—Selected fuels.
2—Operation at lower temperatures.
3—Use of additives.
4—Removal of corrosive agents.

**Fuel selection:** In special cases, fuels selected by crude source and refinery processing may be suitable as is for gas turbines. This, however, would restrict availability. The cost of segregation and distribution might be appreciable. Other than in limited areas, this route is believed to be too narrow to benefit gas turbine development in the industrial field.

**Cooler operation:** Limiting turbine inlet temperatures to 1250° F. or lower has been found to minimize corrosion, and this is commonly practiced in Europe. It sacrifices thermal efficiency for longer blade life. At higher operating temperatures, corrosion may be encountered — around 1350 to 1500° F. This is the practice in the U. S., but auxiliary fuel treatments are practiced, including use of additives and removal of corrosive materials.

**Additives may be used** in two ways:

1—Lowering deposition by raising the melting point of the ash and making it more friable.

2—Reacting with corrosive materials to form non-injurious compounds.

They appear to be the most effective techniques for combatting vanadium corrosion, and the additives presently favored in the U. S. are magnesium compounds. Alumina and silicates may also be beneficial. The magnesium reacts with vanadium to form relatively non-corrosive materials. Magnesium may be added as the oxide, sulfate, or an oil-soluble compound. Any excess magnesium is generally converted to the sulfate. Large quantities of this compound may contribute slightly to deposits, although this has not been considered serious as yet.

**Removing corrosives:** To date, processes for vanadium removal have not been attractive economically. With sodium, removal is definitely possible. One manufacturer has successfully water washed Bunker C with aqueous magnesium sulfate and centrifuged to lower the sodium content 10 to 20 fold.

Treating appears practical and economical chiefly for the consumer. Sodium removal at the refinery would necessitate protection from other contamination. Further, the incorporation of the relatively cheap inorganic agents in either solid form or aqueous solution is most feasible immediately before consumption.

**Table 2—Analyses of Fuel Oils from Various Sources**

| Crude Source | Domestic A | Domestic B | South Amer. | Middle East |
|---|---|---|---|---|
| Sulfur, wt-% | 2.3 | 1.7 | 2.4 | 4.0 |
| Ash, wt-% | 0.09 | 0.07 | 0.08 | 0.04 |
| Metals, ppm: | | | | |
| Sodium | 45 | 110 | 60 | 45 |
| Vanadium | 50 | 10 | 300 | 55 |
| Calcium | 55 | — | 6 | — |
| Magnesium | 10 | 2 | 6 | 25 |
| Nickel | 24 | 5 | 40 | 20 |
| Iron | 55 | 13 | 6 | 10 |

## Industrial & Railroad Lubes

No particularly critical problems seem to be present today in the industrial turbine lubricant field. The operating conditions appear to be comparatively mild. Maximum bearing temperatures do not exceed 200° F., and the most important oil quality requirement is satisfactory oxidation stability so as to permit maximum intervals between oil changes.

**Products normally used are** low viscosity (40 to 60 SUS @ 210° F.), highly refined petroleum oils. Oxidation inhibitors, rust preventives, and anti foamants are often employed to improve base oil quality. Unless radical changes are made in turbine design, currently available lubricants appear satisfactory.

## Automotive Fuels

Since engine builders have not progressed beyond the experimental stage in the automotive field, it is premature to draw up a firm set of specifications defining properties. The background of experience with aviation gas turbine engines may, however, be used to good advantage. It appears that the automobile and aviation fields may tie in rather closely.

**The turbine's major deficiency** in automotive use is its poor fuel economy at part-throttle operations, under which conditions passenger cars operate most of the time.

Eventual usage of the automotive gas turbine may well depend upon the outcome of intensive efforts now in progress to improve engine performance. In any event, price and availability will weigh heavily in determining the types of fuel stocks to be used.

**These factors point to** low octane number distillate fractions covering the gasoline, kerosene, and perhaps diesel fuel boiling ranges. Operating experience has been insufficient to point to any striking fuel, or lube, requirements which merit special investigation.

**Leaded fuels should be avoided,** it would seem, to preclude formation of lead deposits on blades and heat exchangers. However, the turbine engine will be making its initial appearance when gasoline is virtually the only fuel available for automotive use. It ap-

pears, therefore, that the early models of automotive gas turbines must be operable on conventional leaded gasolines.

**Some predictions are possible** regarding the type of fuel which will be required, although there will undoubtedly be marked changes in engine design before any significant commercial quantities of automotive gas turbine fuels are needed.

**The most important factors** will probably be burning quality and carbon forming tendencies. In these respects, it is difficult to visualize the automotive gas turbine as being more critical than the advanced aircraft turbine engine. Materials similar to conventional jet fuels (JP-3, -4, -5) should be satisfactory.

**Other requirements are less severe** than in aviation applications. There are no extremes in altitude and climactic conditions, nor in supersonic speeds, hence thermal stability should not be a fuel problem.

One suggested limitation on the use of the wide boiling range, low octane number, distillate fuels is a maximum end point of 650° F. As for sulfur content, it should probably be maintained low enough to minimize metal corrosion difficulties at the low exhaust temperatures which will prevail in automotive equipment. Low sulfur also tends to minimize the problem of exhaust odor.

### Automotive Lubes

Engine builders have not yet reached the stage where they are concerned over lubricant quality. However, indications are that requirements may be rather severe.

**The oil will have the job** of cooling main engine bearings and lubricating the bearings, accessories, speed reducer, and transmission. This means the lubricant must be stable at peak bearing temperatures of 400° F., and fluid enough to permit engine starting at the minimum operating temperature —say, —20 to —40° F. Anti-foaming characteristics are needed for good performance in the transmission and speed reducer. Load carrying capacity must be adequate for proper lubrication of high speed gears and bearings.

**Synthetic lubes may be required** to meet these properties. Conventional petroleum oils cannot apparently provide the needed characteristics. High viscosity mineral oils coke at elevated temperatures and do not have proper pumpability at low temperatures. Low viscosity stocks are prone to volatilize or form deposits at higher temperatures.

*What About Gas Turbines?*

# Fuel for Commercial Aircraft

THE time has come to select a commercial gas turbine fuel for commercial aircraft, and for a specific definition of that fuel, according to F. G. Dougherty and M. C. Hardin, Allison Div., General Motors Corp.

The two principal contenders in the field today are JP-4 fuel and kerosene. From an engine maker's viewpoint, the use of JP-4 is desirable. It is the one on which all current American engines are developed for military applications, with thousands of operating hours of experience behind it. However, the ultimate customer, the airline operator, has shown a preference to the kerosene type fuel.

**Two points favoring kerosene** are seen as most important to the commercial airline operator:

• **Safety**—In comparing JP-4 and

**Table 3—Comparison of Jet Fuel Specifications with Properties**

| Property | Allison Requirements[1] | Commercial Kerosenes: Allison Survey | Commercial Kerosenes: Esso Survey[2] Range | Commercial Kerosenes: Esso Survey[2] Average |
|---|---|---|---|---|
| Gravity, °API | 40/48 | 41.1/47.1 | 39.4/49.2 | 44.1 |
| Gravity, sp. 60F/60F | 0.788/0.825 | 0.792/0.820 | 0.783/0.828 | 0.806 |
| Net heating value, Btu/lb. | 18,400 (min) | 18,550/18,720 | 18,410/18,720 | 18,570 |
| Dist., % evap.: | | | | |
| IBP, °F | —— | 326/370 | 308/383 | 332 |
| 10%, °F | 392 (max) | 348/405 | 349/398 | 372 |
| 50%, °F | 440 (max) | 405/455 | 382/450 | 425 |
| 90%, °F | 500 (max) | 450/520 | 428/521 | 484 |
| E.P., °F | 572 (max) | 494/560 | 465/555 | 520 |
| Residue, % | 2 (max) | — | — | — |
| Flash point, °F | legal/150 | 120/145 | 110/161 | 127 |
| Smoke point, m.m. | 20 (min) | 20/32 | — | — |
| Sulfur, wt-% | 0.3 (max) | 0.01/0.3 | 0.01/0.24 | 0.08 |
| Freezing point, °F | —[3] | −22/−76 | −20/−60[4] | −40[4] |
| Visc. at 100° F., cs | — | 1.4/2.2 | 1.2/1.9 | 1.6 |
| at −30° F., cs | —[5] | 8/30 | — | — |
| Aromatics, wt-% | — | 3.6/18 | 5.5/18.1 | 12.7 |

[1] "Fuel for Jet Transports," A. R. Ogston, Esso Export Corp.

[2] The fuel shall be an illuminating grade kerosene as defined by burning test requirements of Federal Specification VV-K-211C or its equivalent, and shall meet general quality requirements as to corrosivity, gum forming tendencies, and contaminants required for other aircraft fuels.

[3] The freezing point shall not be less than 10° F. below the minimum anticipated fuel temperature to the engine.

[4] The viscosity shall be 10 cs. max. at the minimum anticipated starting fuel temperature.

[5] Cloud point, not freezing point.

kerosene, neither fuel is consistently superior in its resistance to ignition from all possible sources encountered in aircraft operation or in the event of a crash. However, the general consensus is that the high flash material offers definite safety advantages in the hazards most frequently experienced in airline usage.

• **Economy**—In direct cost, kerosene appears capable of offering a reasonably consistent price advantage over JP-4. It is now widely marketed as a commercial product. Storage and other handling equipment are also presently available for use, hence new facilities costs to be borne by the product appear to be at a minimum.

However, both the direct and indirect cost of the product will be affected if the fuel must be a highly specialized version of kerosene. It is therefore important to take a look at a detailed definition of an acceptable product (see Table 3).

**These requirements were developed** from a study of engine requirements and of production-scale illuminating kerosene fuel analyses. The second column of values in the table shows the ranges of kerosenes obtained from an Allison survey of 15 representative refinery sources in the U. S. Three were on the East coast, eight in the Mid-west and Gulf coast areas, and four on the West coast. Results from a previously reported world-wide survey by Esso Standard Oil Co. are listed in the third column.

**Fuel should be readily available,** judging by a comparison of the specification values and the ranges of properties of present kerosenes, except for possible complications from low temperature requirements.

The API gravity range of 40-48 will include all products in the Allison survey and all but the extremes in the Esso report. The net heating value and sulfur requirement does not restrict any materials. Complete smoke point data are not available, but the minimum value is not indicated to be limiting to illuminating grade kerosenes. Flash point is limited, for engine application, only to exclude extremely high flash materials which might be encountered. Distillation range excludes a minimum quantity of the least volatile materials and is well above the average values reported in the Esso survey.

**Most critical restriction** to availability is low temperature properties, specifically viscosity and freezing point. The availability and competitive advantages of kerosene will probably disappear if a standard is established to satisfy the most severe low temperature requirement that could be encountered. However, these requirements vary with aircraft operating area, flight duration, and the aircraft itself.

It appears desirable that the minimum fuel temperature be established by the airline to fit its own particular operation. This specification therefore states that viscosity shall not be greater than 10 centistokes at the minimum anticipated fuel temperature to be experienced in starting the engine, and that the fuel freezing point be at least 10° F. below the minimum temperature at which the fuel will be delivered to the engine. For certain aircraft operations now under consideration, the minimum fuel temperature has been established at —25° F.

**Other requirements** to consider are related to quality—both in the production and in the intermediate handling process of storage and delivery to the aircraft.

1—The material must not be corrosive to metals. In addition—for good public relations—it must be sweet.

2—It must have storage stability and must not contain any materials which might block filters or cause fuel system malfunction by deposits in valves or other close tolerance parts.

3—It must be free from suspended water and solids as delivered to the aircraft. Control of these contaminants in aircraft gas turbine fuels is very critical. In the first place, these fuels are more viscous than avgases and contaminants settle out more slowly. Secondly, there is a great dependence on automatic devices for control of the aircraft gas turbine engine.

**These requirements should not** be regarded as sacred. Any venture of this type involves a certain amount of prognostication. Subsequent operating experience will undoubtedly show that relaxation or a re-definition of certain requirements is desirable. It may also dictate that certain values be more stringent.

**In the interim development period,** engine builders are welcoming any data and recommendations the petroleum industry may be able to furnish. Both of them as well as the airframe builders have a common responsibility in the success of the commercial gas turbine powered aircraft.

*What About Gas Turbines?*

# Fuel for Automobiles

A SUBSTANTIAL number of passenger vehicles will be equipped with gas turbine engines within a 10-year period, Ford Motor Co. engineers are convinced. They base this on their beliefs that the numerous problems of design, performance, and cost of vehicle turbines will be solved, pointing out however that satisfactory solutions have not as yet been reached.

**The kind of fuel** such powerplants might need was outlined generally in the paper by A. A. Kucher at the NPA meeting. Ford has not assumed any performance cost advantage through lower cost fuels. Broad cut, higher heat content fuels would permit an operating cost advantage provided that the tax structure does not continuously catch up with and remove the price advantage.

**A very wide boiling range fuel** seems to be in order for future engines, since gas turbines thus far have operated successfully with both gasoline and fuel oils. Such a fuel should require fewer and simpler processing steps in its manufacture.

**Certain new requirements** may, however, present themselves. High temperature conditions encountered in the turbine will require that corrosive properties of the combustion products be held to a minimum. If broad-cut fuels are used, the sulfur and vanadium content could create a very serious problem of engine corrosion.

**The problem of carbon formation** can be controlled possibly in a turbine burner of proper design. However, the accumulation of carbon and other

non-volatile fuel components on the intricate passages of the heat exchanger may be a serious problem. Such an accumulation could reduce turbine and heat exchanger efficiency by reducing heat transfer rate and increasing the pressure drop across the exchanger. Fuels having low carbon-forming tendencies will be very desirable.

**With respect to lubricants,** the performance requirements of the automotive turbine will be far more severe than for today's automotive engine. A gas turbine in a passenger vehicle is subjected to continually repeated decelerations and accelerations which impose high "soak-back" temperatures from the turbine vanes, through the disk and into the shaft and the bearings.

**Petroleum based lubes may fail** to satisfy these requirements, it would appear, and it is likely that synthetic lubricants will be used. The synthetic lubes now being used in aircraft are being used in experimental vehicle turbines. These materials are, in general, satisfactory under steady-state conditions. However, the useful top temperature limits of these materials is about 500° F., and the maximum "soak-back" temperature encountered is likely to be at least 100° F. above this. On the other hand, the low temperature requirements for automotive use will not be as severe as for aircraft applications.

The lube will also have to be non-corrosive to the many metals to be involved in the construction of an automotive turbine. Excessive carbon or gum cannot be tolerated in high speed bearings. Thus, unusual thermal, oxidation, and hydrolytic stability will be required in the lube.

Oil consumption will probably be considerably lower than in the conventional passenger car engine of today. Overall quantity requirements for the gas turbine are lower.

*What About Gas Turbines?*

# Fuel for the Navy

THE most important new type of fuel for gas turbines being studied by the U. S. Navy is in the "middle of the barrel." It ranges between the currently used diesel and the Navy specials and has been called "Cosag" fuel. It might, for example, be a heavy distillate comparable to commercial No. 4 fuel oil.

Aim is to establish a single fuel suitable for either gas turbine operation or steam generation. The Bureau of Ships does not yet have a purchase specification for any fuel of this type. As a basis for discussion, the Cosag fuel is defined as a fuel of low ash and carbon residue contents. Compared to Navy Special, it forms fewer salt water emulsions.

**A pilot specification** has been developed and is shown in Table 4 along with analyses of some possible Cosag fuels. No limitation is contemplated on the fuel composition. A blend of compatible distillates and residue types would be acceptable to the Navy if conformance to the properties in the table is obtained.

**The immediate need** for Cosag fuel is limited to experimental lots for evaluation in the Bureau of Ships' laboratories, and for development of specification requirements.

Near future needs would be for performance studies on the Navy's present Cosag test plant, on newly designed equipment and possibly for full-scale fleet tests to compare Cosag with Navy Special in existing equipment. Finally, Navy would anticipate seeking a regular source of supply of Cosag for presently planned gas turbine installations and any future Cosag power plants.

In addition to its investigation of alternate fuels for gas turbines, the Navy is carrying on extensive studies of the engine itself both as the main propulsion device for ships and as auxiliary power units. Basically, all turbine designs under development by the Navy are intended for using Diesel fuel in case no other fuel is suitable.

**Table 4—A New Fuel the Navy Is Investigating**

| | Cosag Pilot Specs. | Analyses of Possible Cosag Fuels | | | |
|---|---|---|---|---|---|
| | | Sample 1 | Sample 2 | Sample 3 | Sample 4 |
| Gravity, °API | 18/22 | 14.0 | 22.2 | 23.2 | 18.9 |
| Flash, PMCC, °F | 150 (min) | 210 | 290 | 340 | |
| Pour point, °F | 20 (max)* | —70 | —45 | —95 | |
| Water & Sediment, vol-% | 0.1 (max) | 0.04 | 0.2 | 6.0 | |
| Sulfur, wt-% | 2.0 (max) | 1.93 | 0.46 | 0.26 | 1.81 |
| Ramsb. Carb. res, wt-% | 1.0 (max) | 1.73 | 0.37 | 0.59 | — |
| Cetane Number | | 18.6 | 50.3 | — | — |
| Cetane Index | | — | 43.2 | — | 26. |
| Ash, wt-% | 0.002 (max)** | 0.003 | 0.003 | 0.001 | 0.006 |
| Vis., SU at 100° F | 100 (max) | 104 | 95 | 500 | 44.6 |
| Aniline point, °F | | — | — | — | 95.3 |
| ASTM Dist | | | | | |
| IBM, °F | | 396 | 586 | 512 | 284 |
| 10%, °F | | 467 | 642 | 659 | 457 |
| 30%, °F | | 489 | 657 | 711 | — |
| 50%, °F | | 536 | 672 | — | 580 |
| 70%, °F | | 650 | 694 | — | — |
| 80%, °F | | 665 | 712 | — | — |
| 90%, °F | | — | 732 | — | 723 |
| E.P., °F | | — | — | — | 766 |
| Metals, approx. ppm.: | | | | | |
| Vanadium | | 1 | 1 | 1 | |
| Sodium | | 3 | 2 | 1 | |
| Calcium | | 3 | 1 | 1 | |
| Magnesium | | 2 | 1 | 1 | |
| Aluminum | | 2 | 3 | 1 | |
| Silica | | 2 | 10 | 3 | |
| Nickel | | 3 | 1 | 1 | |
| Iron | | 5 | 3 | 1 | |
| Zinc | | — | 1 | — | |

* Upper pour point.
** Up to 0.01% acceptable if neither sodium nor vanadium exceeds 10 ppm.

By **WILLIAM F. BLAND, Editor**

ON Saturday, August 27, the Whiting, Ind., refinery of the Standard Oil Co. (Indiana) had an explosion and subsequent fire. It was one of the most disastrous accidents in modern petroleum processing history.

**How do you fight such a fire,** how do you keep it from spreading, how do you shut down the rest of the plant, how do you handle the problems that always arise at such times, how do you get the plant back onstream?

That's what we have tried to find out. We have reviewed the various accounts of the fire, we have talked to engineers not with Indiana Standard but familiar with the plant, and we have put some specific questions to Indiana Standard people. We weren't looking for the pat answers to what you're supposed to do according to the nicely worked out plans that are on the shelf. We wanted to learn what real people actually do under real conditions.

**Here are the answers—but only some of them.** It will be months before the complete picture of what actually happened and what was done to cope with the situation can be pulled together. This story has been written with a conscientious effort to refrain from being sensational or spectacular.

But it's hard not to be impressed when a brand new $8-million unit has been splashed around the countryside and a million barrels of crude and products have gone up in smoke.

This story and the information it contains (and the complete story, when it can be told) should help the entire petroleum processing industry do a better job—of fire protection in the first place, and of fire fighting if the protection fails. You can profit from the experience of Indiana Standard.

**FIRE! What Then?**

# What Happened at Whiting?

AT 6:12 am on Saturday, August 27, the 5-month-old Orthoformer at Indiana Standard's Whiting refinery exploded. The unit itself, a regenerative-type catalytic reformer, was virtually demolished. Flying fragments from it set off tank fires which eventually consumed over a million barrels of crude oil and products, and destroyed about 70 storage tanks, two pumping stations, and a gasoline treating plant.

Outside the plant, concussion and debris from the blast killed one 3-year-old boy in a residential area adjacent to the plant, injured a number of other persons, wrecked several houses and two automobiles, and caused glass breakage and other minor damage as far away as 3 miles. Actually, the extent of damage outside the plant was not nearly as extensive as early newspaper accounts indicated.

Besides the severe damage to the Orthoformer, about 10% of the refinery area proper was destroyed, according to Robert E. Wilson, Chairman of the Board for Indiana Standard.

Dr. Wilson stated that damage "will probably exceed $10,000,000." Other unofficial estimates put it at $20-million, and it will more likely be higher when all added up.

Plant damage in excess of $1-million is covered by insurance. The company did not, however, carry public liability insurance, so that all claims for damages outside the refinery as a result of the accident will be its own financial responsibility.

The Whiting refinery of Indiana Standard covers an area of 1660 acres. It is situated within the city limits of Whiting (population, 10,000), on the south shore of Lake Michigan, and about 16 miles southeast of the Chicago Loop. The main processing area of the plant is bounded roughly on one side by the Pennsylvania Railroad main line tracks, on the south by 129th St., and on the other side by Indianapolis Blvd.—although extensive tank farms are located beyond these boundaries. Indianapolis Blvd. is a main through traffic artery—U.S. routes 12 and 20. (See plot plan.)

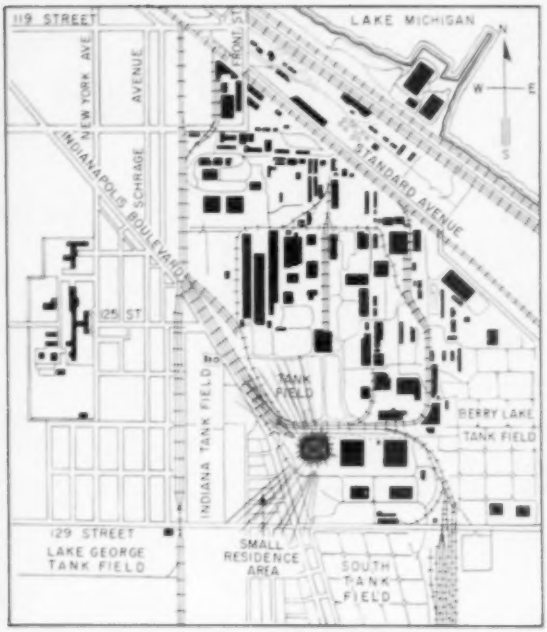
The Orthoformer, where the explosion occurred, is located in the lower part of the processing area, flanked on the east by two Fluid catalytic cracking units and on the west by Indianapolis Blvd. There is a small but concentrated residential area to the southwest of the unit—on the other side of Indianapolis Blvd. and extending down to 129th St. There is (or was) a concentrated tank area immediately to the north of the unit. Tanks in that area bore the brunt of the fire loss.

**When the initial explosion** took place Saturday morning, fragments of the unit were blasted in essentially two directions. Some pieces flew to the southwest, doing considerable damage to the residential area in that direction. Others went into the tank farm north of the unit, rupturing numerous tanks. These fragments were of various sizes, shapes and material, but most destructive among them were chunks of steel 2½ in. thick and reportedly in some cases as much as 25 ft. long.

**A number of separate fires** were started immediately in the ruptured tanks, apparently touched off by sparks struck by the metal fragments as they pierced the tank walls or roofs.

The Orthoformer itself was never seriously on fire, and the flames on it were completely extinguished within an hour and a half following the explosion. Inspection of photographs of the damaged unit indicated little evidence of fire, but extensive blast damage. The main reactor-regenerator unit and auxiliary structure were a mass of debris, as was the inert gas compressor house. The main large preheat furnace and stack were still standing, but with the side of the furnace adjacent to the reactor-regenerator ripped open, exposing the tubes—to their full length in many places.

**MAJOR FIRE DAMAGE CAME AFTER EXPLOSION** of catalytic reforming unit as flames raced through storage tanks in areas adjacent to the process unit (see plot plan, next page)




**BIG FIRES GOT STARTED** when "flying missiles" pierced tanks in field north of the exploded reforming unit. Broad diagonal street is Indianapolis Ave. (see map at right showing missile paths)

**HOW BLAST PATTERN STRUCK OUT** at tank field north of explosion and at residential area to southwest, across Indianapolis Ave. (see photo at left; damaged reformer is in front of smoke column)

ripped open, exposing the tubes—to their full length in many places.

The control room for the unit was considerably broken up by the explosion, but not leveled. Two smaller furnaces, the catalyst storage drum, and three towers (polymer stripper, debutanizer, and absorber) were still standing, but draped with tangles of mangled piping.

**The fire spread rapidly** through the tank farm, and fire alarms were sounded almost continuously from 6:12 a.m. A major disaster alarm—three long blasts on the plant's steam whistle—was sounded about 7 a.m. The entire plant was shut down shortly thereafter.

All fire fighting equipment at the plant was immediately brought into action, supplemented by men and equipment from surrounding towns. No outside equipment was used in the plant, however; it was employed on the outside—pumping water on still-intact tanks, extinguishing scattered small fires beyond the plant area, and preventing the fire from spreading across Indianapolis Blvd.

A number of explosions occurred throughout the day as additional tanks caught fire. One particularly vicious one let go in the afternoon, when a tank of naphtha feed stock exploded.

Oil seeped into the city sewer lines along Indianapolis Blvd., with the subsequent danger of possible explosions wherever the fumes travelled. As a result, a disaster emergency was declared by Whiting city authorities.

**Fifteen hundred persons** were evacuated from 500 homes in an area of nearly 2 sq. miles as a result of the sewer problem, all gas and electricity to the area was cut off, and a strict no-smoking rule was enforced. The smoking ban was lifted Sunday, but some evacuated families weren't allowed to return to their homes until the middle of the week.

By 10 p.m. Saturday the company reported that the fire was no longer spreading and appeared to be contained. "It covers no greater an area than it did five hours ago," said A. F. Endres, refinery manager, "and the actual area of the fire has been reduced."

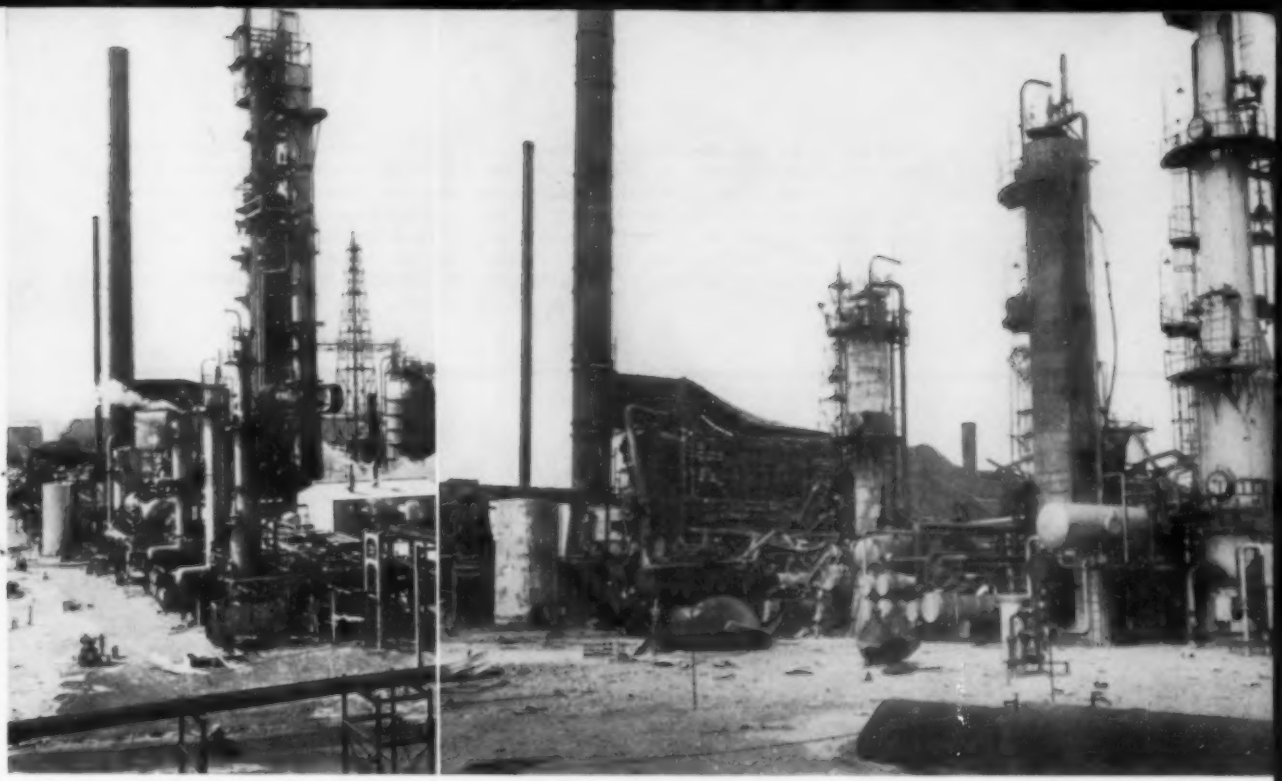
It was not until noon on Sunday, nearly 30 hours after the fire started, that it was reported as under control. Even then, tanks continued to burn for another week. The last flames were extinguished the following Sunday, Sept. 4—eight days later.

Indiana Standard had several things to be thankful for in this fire—disastrous as it was:

**Loss of life was miraculously low.** Aside from the youngster killed by the piece of metal from the Orthoformer, only one other death resulted—and that was only indirectly a result of the fire. Walter Rhea, 61, asst. general foreman of the plant's light oils division, suffered a heart attack when he reported for fire fighting duty Saturday.

Only mild winds prevailed during the fire, and for the most part were from the south and southeast. They aided materially in preventing a further spread of flames. They also helped to save the city of Whiting from being blanketed with a dense cloud of black, oily smoke—since the winds carried the smoke across the plant and out over Lake Michigan.

The accident happened during the early morning and on Saturday—when there was little traffic. If it had taken place on any other week day morning at 6:12—or even a little later on Saturday—Indianapolis Blvd. would have been jammed with traffic. In that event, the cars abandoned during the ensuing panic would have hopelessly clogged that main artery and prevented the movement of fire equipment and other emergency vehicles. As it was there was only one automobile on the highway near the Orthoformer at the time. The driver fled his car, which was subsequently (although hours later) engulfed in the fire that crept across the road at that point.



**BEFORE AND AFTER**—at left is Orthoformer as it looked before the explosion. At right: what was left afterwards. Reactor-regenerator (a piece of the shell is still visible) was at right of main preheat furnace. Furnace is at left, with stack still there

**FIRE! What Then?**

# The Orthoformer—and the Explosion

THE Orthoformer is basically a Fluid Hydroformer for catalytic reforming of naphtha, using molybdenum oxide on alumina as the catalyst.

The process includes continuous catalyst regeneration, during which coke and sulfur are burned from the catalyst by blowing with air. Typical operating conditions call for temperatures of 900-950° F. in the reactor, 1050 to 1125° F. in the regenerator. Pressure level for the process is 200-250 psig., with regenerator pressure controlled 5 to 15 psig. higher than the reactor pressure.

Orthoformer design differs from the conventional side-by-side reactor-regenerator design of a Hydroformer in that the reactor and regenerator are integrated into a single vessel, with the regenerator on top. As a result, all external catalyst transfer lines are eliminated, and catalyst flow occurs in straight, internally located lines. A cross-section view of the unit is shown in the accompanying sketch.

Although five Fluid Hydroformers of the side-by-side design have been built and are in operation, the Indiana Standard Orthoformer is the first and only in-line design unit ever built. It has a design charge capacity of 25,000 b/d. It was completed this past spring by M. W. Kellogg Co., and put on stream April 2.

The total Orthoformer structure towered as high as a 26-story building, or about 260 ft. The reactor portion was 130 ft. tall and 24 ft. in diameter. It was field fabricated of carbon-½ moly steel, varying in thickness from 2⅜ to 2½ in. It was stress relieved in place before affixing the regenerator and internal head atop it. The regenerator atop the reactor was 70 ft. tall and 13 ft. in diameter. It was shop-fabricated of 1½-in. steel. It was necessary to shop forge the 3-in. thick intermediate head and transition piece of chrome-moly steel to avoid graphitization.

Shell seams of the reactor were joined by automatic welding under essentially shop conditions. This vessel is believed to be the heaviest pressure vessel ever built, containing over 500 tons of steel.

At the time of the explosion the unit was being started up after several previous runs. During the earlier runs, according to report, it performed satisfactorily except for the usual equipment problems in a new unit.

Reconditioning of the unit after the previous run had been completed Tuesday, Aug. 23, and start-up operations were begun the morning of Friday, Aug. 26—the day prior to the explosion. The unit was still being brought up to operating conditions when the explosion occurred at 6:12 a.m. on Saturday, Aug. 27. No catalyst had been fed into the system, although naphtha charge stock was being circulated.

Exactly what caused the explosion isn't known, although the company is now conducting its own investigation into it. Until such time as its studies are completed, however, it is unwilling to make even any conjectures as to what might have happened.

One theory is that the explosion took place in the reactor—the lower of the two vessels. Pieces of the top half of the reactor shell were found as far

away as 1500 ft. The lower half of the reactor, although torn apart, was not dissipated over a wide area. The regenerator—the upper of the two vessels—toppled over when the reactor was blown out from under it, but photos show it still virtually intact.

In one respect, there should be little difficulty in reconstructing the events prior to the mishap. There were seven operators on the unit at the time, and all of them escaped. Only one was seriously injured—being struck on the back of the head with a piece of debris—and he is not in critical condition. The control room, although severely damaged by blast, was not destroyed—so that recorded operation data are available. The company is making a thorough study of all records pertaining to the unit and its operation in its continuing investigations.

---

## FIRE! What Then?

# Problems—and Their Solution

**COMMUNICATIONS WERE KNOCKED OUT** when poles and power cables were damaged. Large, broken water line was a problem too, though not serious

**QUICK SPREAD OF FIRE AREA** was another problem, licked by rapidly throwing up emergency fire dikes of sand around danger area

THREE big and relatively unexpected problems confronted the refinery people in the course of fighting this fire:

1—Communications
2—Power Supply
3—Scope of Fire Area

**Communications were knocked out** within the plant and from the plant to the outside shortly after the fire started. Their failure was caused by the fact that all telephone connections are centralized in one switchboard, located in the company's main Administration and Engineering Building on New York Ave., about ¾ths of a mile from the center of the plant. All plant phones worked through that switchboard, and were connected to it through one main cable—which ran directly through the heart of the fire area and was lost within a matter of minutes.

As soon as that telephone cable was lost, it was impossible even to call from one station to another within the plant. There were still a few telephones in service—direct lines to the Whiting exchange of Illinois Bell Telephone Co., but they were isolated and could not be used to call anywhere else in the plant.

Radio-telephone communications were available, since about 36 trucks and cars in the plant are so equipped—primarily for dispatching purposes. But even these were rendered partially ineffective. There are six monitoring stations in key locations throughout the plant for coordinating all radio-telephone messages. These, however, are not self-contained; they depend upon a main transmitter in the Administration Building for all sending and receiving, and are connected to

**IT PAYS TO FIREPROOF.** These pipe stands were in middle of fire, yet structural members encased in fireproof concrete saved them

that transmitter by cable. Like the main telephone cable, these lines were also lost early in the fire. With no connections to the transmitter, the monitor stations were dead. It was possible to talk from one radio-equipped truck to another, but not to one of the six key stations—which included the fire marshal's headquarters. The system was like a chicken without its head.

As soon as it was realized that communications were lost, one of the mobile radio-telephone units was moved in next to the fire marshal's headquarters and parked—which at least made it possible to relay messages and instructions back and forth by shouting. By Saturday evening, the local Motorola people had brought in several portable units, adjusted them to the frequency Indiana Standard uses, and set them up in key locations to replace the useless monitor sets.

As quickly as possible—but even that was a slow process—temporary telephone lines were installed in the plant connecting directly with the outside Bell system. That made is possible to call those few key spots or the main Administration building.

**The power supply** was another problem—although apparently only a potential one. The Whiting refinery generates all its own power, using excess gas from the various operating units in the plant as its major source of fuel.

As these different units started to come off stream, the supply of fuel gas was correspondingly reduced, and there was considerable concern for a time as to whether the power plant could continue operating. The boilers are equipped to burn fuel oil, but the central pumping station which could feed that oil to them was in the heart of the fire.

Fortunately, it was possible to make arrangements with a neighboring refiner to bring oil in by tank truck. The boilers were still being fueled in that manner some days later.

If the generators had shut down because of a lack of fuel, the plant would have been entirely without power—except for a few standby gasoline-engine driven water pumps. The refinery buys no outside electricity, and has no outside hookups that could be used in such an emergency.

**The size of the fire area** was so large as to make the conventional fire fighting techniques entirely unworkable.

Instead of the usual fire in one or a few tanks, and concentrated in a small area, this one covered 10 acres at its height. Within a matter of minutes after the explosion, the entire tank field which was bombarded by fragments from the Orthoformer was in flames.

According to one report, there was a fire area rather than a fire. It was immediately obvious that it wasn't something that was going to be put out. So the thing to do was to establish frontiers and hold the line as far as possible.

As a result, every effort was concentrated right from the start on keeping the fire from spreading. The company's fire-fighting crews set up hoses all around the periphery of the fire, and surrounded it with a wall of water.

There was danger at times on Saturday and early Sunday that the fire might spread even beyond the area to which it was then confined. Tremendous quantities of oil were let loose initially when tanks were ruptured by pieces of the exploding Orthoformer. Some tanks which weren't hit caught fire because they were in the same diked area as a ruptured tank and were engulfed in the flaming oil, or were simply too close to another burning tank. In some cases they burst and added their oil content to the already-full diked areas—thus spreading the fire. Conventional practices, according to reports, had been followed in diking the area.

To contain the fire, Indiana Standard did something which they haven't usually found necessary before. They used tremendous quantities of sand to throw up large dikes on the outskirts of the fire area.

Some sand was available in the refinery from a stockpile kept on hand for construction purposes. It wasn't nearly enough, however, and outside sources were called on in a hurry. Local trucking concerns and building materials supply firms were contacted and asked to haul in all the sand they could. Appeals were broadcast over radio stations in Whiting and neighboring communities for anyone with a truck and sand to bring it in.

Trucks came to the refinery's gates and were directed from there as to where to dump their loads.

The effort was successful—because the fire was kept from getting out of its initial bounds except in a few isolated and easily controlled spots.

What will be done with all this sand piled around the refinery? As soon as there was no longer any danger of the fire spreading, the dikes were torn down and the sand spread around by bulldozers to mop up the spilled oil.

FIRE! **What Then?**

## Shutting Down

COMPLETE information on the sequence of events in shutting down the refinery after the fire started isn't yet available—since most of the people who can piece it together are too busy concentrating on the more important job of getting it back on stream.

As far as we have been able to determine from available records, this was the first time in the history of the Whiting refinery that it has been completely off stream. The order for such a complete shutdown can be issued only by a management person—the plant manager, general superintendent, or the assistant general superintendents. We haven't been able to learn who actually gave the order—or when. But it was apparently issued within a few hours after the initial blast and as soon as it became evident that the fire not only wasn't going to be extinguished in the near future but might even continue out of control for some time.

A general shutdown was deemed essential for several reasons—to free all possible men for fire fighting duty, to reduce as much as possible any extraneous demands on water, to minimize the danger to other operators and units in the event the fire continued to spread.

Before the general shutdown was ordered, however, individual units were being taken off stream. Even the stillman who is operating an individual unit has the authority to shut down his unit if he thinks continued operation is unsafe. He isn't supposed to wait for someone higher up to come along and tell him to shut down; he's supposed to exercise his own judgment and take appropriate action.

A complete shutdown of the light oils area was reportedly ordered within minutes after the explosion. That included the plant's two Fluid catalytic cracking units, adjacent to the Orthoformer and in the most immediate danger. Except for minor external damage, they were still in operating condition.

**NEW POWER LINES AND POLES** were erected even while fire still raged in the plant, providing needed electricity fast

**MOPPING UP WAS EASED** by spreading out of the temporary sand fire dikes and using the sand to soak up spilled oil

FIRE! **What Then?**

# Getting the Plant Back Onstream

Just how soon and to what extent the refinery would be back on stream was still a matter of some conjecture even when the fire was nearly out. The best estimate was that it would take about two weeks from the time the fire was finally extinguished to start running crude again. That would have meant somewhere around Sept. 19.

**Two big problems faced the company**—the loss of the central pump house in the heavy oils storage tank field, and the loss of about 70 tanks in the same field.

**The central pump house** was really the nerve center of the plant. All incoming crude (except for a small amount of heavy Tipro crude shipped in by tank car) came in through that station, which also handled a good deal of the transfer of intermediate and finished heavy and middle distillate products. It was a complete loss, and presented a very serious detriment to getting the plant back into operation.

It was planned to get crude into the plant by bypassing this pumping station and the four working crude tanks that were lost. Crude for the Whiting refinery comes in by pipeline, and is received at the Lake George tank field a few blocks southwest of the plant. That field was undamaged except for the loss of its main 2,300 volt power line.

From Lake George tanks, crude was in the past transferred to the four working crude tanks, and then pumped to the individual crude units as needed. As a temporary expedient, it was planned to connect the ends of the incoming pipelines from the Lake George tanks directly with individual crude units, and use the transfer pumps at Lake George as booster pumps, pushing crude into the lines while the crude units own charge pumps pulled on them.

**The problems of tanks** was even more complicated, and the refinery is going to have to tighten up considerably on its tankage.

Aside from the four crude tanks, the lost tankage had a capacity of over 700,000 bbl. of intermediate, semi-finished and finished products—gasoline, distillates, and residuals.

The company will probably have to change the service of some of its remaining tankage, so that one tank here and another there can be freed and its service temporarily altered to substitute for some of the lost tankage.

That tightening up is likely to pose a flexibility problem. Whereas in the past the refinery might have had two shipping tanks for a particular product, now it might have only one. That will require closer scheduling of operations to prevent shipping delays.

Besides shifting tankage at the refinery, another possibility that was being explored was the movement of products to the area from the company's other refineries.

**The treating plant** which was lost probably won't be a major problem. There is enough treating capacity still available in other parts of the plant to handle all the product the refinery will be making until the lost facility can be replaced.

**Naphtha reforming** to upgrade gasoline likewise won't be a problem, even though the new Orthoformer is completely out of service. The old 13,000 b/d fixed-bed Hydroformer which Indiana Standard installed during World War II is still intact and operating.

As a matter of fact, it had been planned to take the fixed-bed unit out of gasoline service as soon as the Orthoformer was fully on stream, so it means only a postponement of that date until the Orthoformer is rebuilt or another type of unit installed.

**Seven steps in getting the plant back** into operation have been outlined:

1—Recondition all shut-down units—and that includes every processing unit in the plant. They'll have to be opened up, inspected, and repaired or reconditioned where necessary before they can be put back on stream. Essentially, there'd be a complete turn around on each unit, which was expected to take maybe four days on some of the smaller ones but perhaps two or three weeks on the larger ones (like the Fluid cracking units).

2—Restore utilities — steam and power—where they went through the fire area. Fortunately, there was little damage to water lines, since most of them are underground.

3—Replace crude charging stocks and the facilities for handling them on a temporary basis.

4—Rearrange facilities for storing intermediate products, switching permanent tankage to working tankage where necessary.

5—Rearrange treating facilities to compensate for those lost in the fire.

6—Restore working stocks of intermediate products.

7—Rearrange facilities for storing finished products.

Concurrently with these seven steps, some of which would be handled simultaneously and all of which would overlap to some extent, there were a number of over-all plant jobs to be done—cleaning up the debris and muck, cleaning out clogged sewers, replacing plant communications, relaying railroad sidings, and the like. Restoring the plant telephone system itself was expected to take at least two weeks.

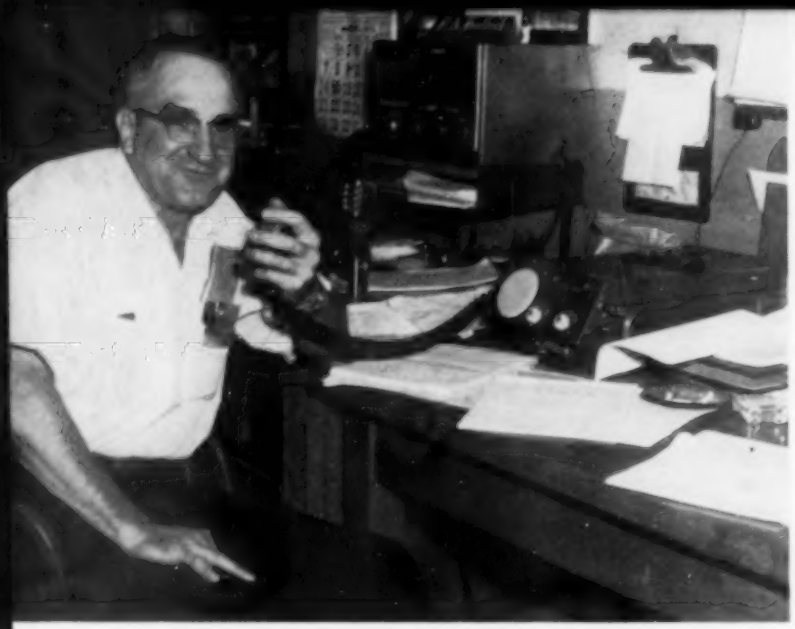
The company was planning to handle all of this work of rehabilitating the plant with its own men.

### *Onstream Progress Report*

Returning to full-scale operations at Indiana Standard's Whiting refinery has been a long, hard pull.

Company officials have estimated that by Sept. 24, about 50% of plant capacity will have been reached—100,000 b/d, and that by Oct. 15, throughput will hit 150,000 b/d as additional crude units return to operation. A. F. Endres, plant manager, said limited operations had been resumed on Sept. 9, almost two weeks after the fire.

The company also will speed up construction of a new 14,000 b/d Ultraformer, originally scheduled for completion in 1957. Ultraformer is Standard's own design.



**KEY MAN IN FIRE ORGANIZATION** at Whiting is Frank A. Horlbeck, chief fire marshal. He directed activities of huge fire brigade by radio-telephone from his headquarters and by tireless first-hand contact in the plant

**FIRE! What Then?**

# Fire Protection—a Prepared Plan

THE Whiting refinery is reported to have one of the best plant organizations for fire protection of any refinery in the U. S.

It has had an enviable record over several years of less than four siren calls a month—a siren call being a fire alarm for which specially trained crews and heavy fire-fighting equipment are called out. There are, of course, other small fires, but they are so negligible and quickly disposed of that even the fire marshal doesn't know about them until he receives a report immediately after the fire is put out.

**The physical fire-fighting setup** at Whiting is relatively simple. The refinery is provided with a high-pressure looped water system including 11 stationary fire pumps with capacity of 28,200 gallons a minute, 423 fire hydrants, 61 turret nozzles around major processing units, 628 stationary hose reels, 18 wet sprinkler systems, 11 dry sprinkler systems, 4 water tanks with 11.5 million gallons for emergency purposes.

Equipment includes a fire training field, seven fire trucks including one pumper, 24,200 ft. of 2½-in. hose, 14,625 ft. of 2-in. hose, 40,200 ft. of 1½-in. hose, 47 hose carts, 16 fixed $CO_2$ systems manually operated for pump rooms, 1,609 $CO_2$ extinguishers, 130 dry chemical extinguishers, 199 carbon tetrachloride hand extinguishers and 916 fire blankets. Movable equipment is stored at 49 fire stations.

**A refinery fire committee** is one of the important factors in Indiana Standard's fire protection system. That committee is composed of representatives from all the refinery divisions except accounting. It includes department heads, division superintendents and general foremen. In addition, it has representation from the executive group, research, engineering, and the company's insurance office. A safety department representative is secretary. With this membership, informed opinion is immediately available in discussing every type of problem that arises.

### 734,000 Bbls. Lost

Product losses resulting from the Whiting refinery fire were given in the API weekly report on refining operations for the week ending Sept. 2, 1955. They are:

| | |
|---|---|
| Gasoline | 179,000 bbls. |
| Kerosine | 56,000 bbls. |
| Distillates | 98,000 bbls. |
| Residuals | 401,000 bbls. |

According to API, these figures may not include other losses of products not regularly reported to API, and do not include any figure on crude oil losses.

The committee reviews and studies all matters pertaining to fire hazards, fire prevention and extinguishment. It makes recommendations to the refinery management on existing facilities and new engineered projects, checks the progress on approved recommendations, and also sets up fire prevention policies. It meets monthly or whenever specially called.

The main committee is further divided into 11 permanent subcommittees: 1) Technical Service and Development and Experimentation; 2) Engineering, Codes and Regulations; 3) Utilities; 4) Personnel Organization and Training; 5) Light Oils Processes; 6) Heavy Oils Processes; 7) Building Protection and Evacuation; 8) Roads; 9) New Projects Fire Protection; 10) Car, Truck Loading Racks and Docks; and 11) Asphalt Division Processes.

Day-to-day inspections of offices, warehouses, and storage sheds, and weekly inspections of the plant are made by the refinery's executive subcommittee, the refinery fire subcommittees, the management safety committee, the plant protection department, and the refinery's fire marshals. All violations are reported in writing to the department involved, as well as to the refinery fire committee and the plant fire protection department, which check frequently with the department involved until the hazard is eliminated.

**MOVING IN FAST,** well-trained fire-fighting crews of Indiana Standard employes attacked the fire area at several locations

**Chief fire marshal** at the plant is Frank A. Horlbeck, who has been a member of the fire protection department since 1932, and in his present post since 1942. He heads a full-time staff of 11 fire marshals who work on a three-shift basis and form the nucleus of a first-line fire-fighting brigade.

The refinery tries to maintain roughly 300 refinery employees fully trained in fire technique. They are backed up by another 300 partly-trained personnel, also regular refinery employees.

Training classes are held in a specially built fire training field located in a safely remote corner of the refinery. In 1954, a total of 2,516 men attended classes in some 80 sessions. Training for each first-line fire crewman consists of two hours of drill every third week in the outdoor field from May to November, plus occasional indoor drills in winter. Second-line fire fighters are trained periodically.

**When a fire breaks out** in one part of the refinery, this is what normally happens: Employees on the job quickly attempt to control and extinguish the fire with extinguishers and hose reels placed at strategic locations throughout the refinery.

If the fire is bigger than the immediate personnel can handle, an alarm is turned in over the nearest telephone. The refinery's telephone operator, schooled to receive alarms and give them priority, sounds the alarm—with automatic disks—so that the siren will indicate by short and long blasts which of 12 fire zones is involved.

Immediately all use of the high-pressure water system is stopped, except for fire-fighting, and the pressure—recorded constantly in Chief Horlbeck's office—is boosted to 175 psi. Key personnel of the affected refinery division are notified, wherever they may be.

The refinery maintains three trained crews, totaling 30 men per shift, who go in fire trucks to every siren call fire. This is in addition to the fire marshals with their two fire trucks. Two more trucks are held in reserve.

Crewmen are chosen primarily by job—those who can most readily be spared without affecting refinery operations.

The fire marshal is first telephoned the exact location of any fire. He reports immediately to the scene and, along with those in charge of unit operations, assumes command.

If the fire cannot be brought under control by the first-call crews, a second alarm is phoned in to the operator, who repeats the alarm. Then 60 to 80 additional men and the two remaining trucks will respond.

If the fire should be one of the extremely rare major fires at the refinery, the plant's steam whistle, which ordinarily sounds shift changes, lets out three long blasts, a call for more fire fighters. Whether an employee is at home, shopping downtown in Whiting, or visiting friends in his off-hours, he is expected to respond to the alarm and give whatever assistance he can.

In the refinery fire regulations, the Number 1 instruction reads, "You are the fire department regardless of your regular job."

### *A Safe Place to Work*

The Whiting Refinery of Indiana Standard has an enviable safety record. During the first six months of this year, the plant received two API Accident Prevention Awards for a million or more man-hours worked without a disabling injury. One was for 2,004,765 hours, and the other for 2,412,954 hours.

For the past three years, 1952, 1953, and 1954, the refinery has won the National Safety Council's honor award, its highest recognition of safety practices.

**Photo Credits**

Front cover, United Press photo; pp. 1560-1561, International News photo; pp. 1562, 1568, and 1569, Wide World photos.

## What the Pilot Plant Results Show

**TABLE 1**—Using 84 F-1 Clear Catalytic Reformate from 260-385 F East Texas Crude

| Run number | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soaking Factor(1) | 4.0 | | 4.2 | | 6.5 | | 7.5 | | 8.0 | | 8.7 | | 10.2 | |
| Yields | wt.% | vol.% | wt.% | vol.% | wt.% | vol.% | wt.% | vol.% | wt.% | vol.% | wt.% | vol.% | wt.% | vol.% |
| $C_5+$ reformate | 88.4 | 87.1 | 86.9 | 85.7 | 82.5 | 80.8 | 80.4 | 78.2 | 79.3 | 77.4 | 79.4 | 76.9 | 74.5 | 71.8 |
| Tar | 2.0 | 1.6 | 2.7 | 2.2 | 3.7 | 3.0 | 4.3 | 3.5 | 5.4 | 4.4 | 4.3 | 3.5 | 5.6 | 4.5 |
| Dry gas, $C_4$ and lighter | 6.2 | — | 6.3 | — | 8.6 | — | 9.9 | — | 9.7 | — | 11.0 | — | 13.8 | — |
| Pentenes | 2.0 | 2.5 | 1.6 | 2.0 | 2.3 | 2.8 | 2.0 | 2.4 | 1.9 | 2.3 | 3.0 | 3.7 | 2.4 | 2.9 |
| Pentanes | 2.2 | 2.9 | 2.8 | 3.6 | 2.4 | 3.0 | 2.7 | 3.5 | 2.9 | 3.7 | 1.8 | 2.2 | 2.0 | 2.6 |
| Butenes | 2.1 | 2.8 | 2.4 | 3.1 | 2.6 | 3.4 | 2.9 | 4.0 | 2.9 | 3.9 | 3.3 | 4.5 | 3.6 | 4.8 |
| Butanes | 1.3 | 1.8 | 1.7 | 2.4 | 2.6 | 3.6 | 2.5 | 3.4 | 2.7 | 3.7 | 2.0 | 2.9 | 2.5 | 5.5 |
| Propene | 1.5 | — | 1.4 | — | 2.0 | — | 2.1 | — | 1.8 | — | 2.7 | — | 2.8 | — |
| Potential catalytic polymer (calc.)(2) | 2.8 | 3.0 | 3.0 | 3.3 | 3.6 | 3.9 | 3.9 | 4.2 | 3.7 | 4.0 | 4.6 | 5.0 | 5.0 | 5.4 |
| Inspections | $C_5+$ | Heavy Polymer | $C_5+$ | Heavy Polymer | $C_5+$ | Heavy Polymer | $C_5+$ | Heavy Polymer | $C_5+$ | Heavy Polymer | $C_5+$ | Heavy Polymer | $C_5+$ | Heavy Polymer |
| Gravity, °API | 42.1 | 9.4 | 42.7 | 14.1 | 41.5 | 13.1 | 41.3 | 11.2 | 38.7 | 11.0 | 40.2 | 11.0 | 39.2 | 8.5 |
| Distillation, ASTM, °F. | | | | | | | | | | | | | | |
| IBP | 142 | — | 120 | — | 130 | — | 118 | 430(3) | 160 | 482 | 124 | — | 130 | 465 |
| 10% | 228 | — | 202 | — | 213 | — | 189 | 496 | 225 | 506 | 208 | — | 205 | 516 |
| 50% | 298 | — | 295 | — | 298 | — | 293 | 575 | 295 | 570 | 296 | — | 298 | 592 |
| 90% | 362 | — | 356 | — | 368 | — | 358 | 830 | 360 | — | 366 | — | 364 | — |
| EP | 422 | — | 418 | — | 418 | — | 417 | 883 | 410 | — | 421 | — | 426 | — |
| RVP | 3.0 | — | 3.5 | — | 4.0 | — | 3.9 | — | — | — | 2.9 | — | 3.5 | — |
| Octanes | | | | | | | | | | | | | | |
| F-1 clear of $C_5+$ | 93.1 | — | 94.6 | — | 96.2 | — | 97.4 | — | 98.5 | — | 98.1 | — | 99.6 | — |
| F-1 clear of $C_5+$ and catalytic polymer (calc.) | 93.5 | — | 95.0 | — | 96.6 | — | 97.8 | — | 98.8 | — | 98.5 | — | 100.0 | — |
| Composition of heavy polymer free $C_5+$ reformate | | | | | | | | | | | | | | |
| Paraffin, vol.% | 27.0 | — | 25.2 | — | 21.2 | — | 17.2 | — | 18.7 | — | 17.1 | — | 12.2 | — |
| Olefin, vol.% | 6.3 | — | 6.5 | — | 6.0 | — | 7.3 | — | 6.9 | — | 6.1 | — | 5.6 | — |
| Naphthene, vol.% | 3.0 | — | 3.0 | — | 2.8 | — | 3.1 | — | 3.2 | — | 2.7 | — | 2.8 | — |
| Aromatics | | | | | | | | | | | | | | |
| Alkyl + benzene, vol.% | 61.0 | — | 62.5 | — | 66.3 | — | 68.8 | — | 68.3 | — | 71.0 | — | 76.3 | — |
| Alkenyl, vol.% | 2.7 | — | 2.8 | — | 3.7 | — | 3.6 | — | 2.9 | — | 3.1 | — | 3.1 | — |

(1) Soaking factor is coil volume times reaction rate relative to 800° F. divided by the oil charge rate and has units of ft.³/bpd.
(2) Assumes 95% recovery of butenes, 75% recovery of propene and 90% conversion to polymer.
(3) Vacuum assay.

# High Octanes from 'Iso-Plus'

**By HEINZ HEINEMANN, J. B. MAERKER, F. R. WALSER and F. W. KIRSCH**
**Houdry Process Corp.**

THE increasing use of high compression engines has rapidly pushed octane number requirements of automotive fuels to a level which appeared impractical only a few years ago. Almost one-half of all automotive fuel consumed in the United States today is of premium grade, having a current octane rating of 95-97 F-1. Indications are that octane requirements will continue to increase.

A few years ago it was found necessary to upgrade straight run gasolines to an octane value which would not appreciably lower the anti-knock characteristics of catalytically cracked gasoline after blending. A number of successful reforming processes were developed for this.

Today, however, it is advantageous to be able to produce a refinery gasoline pool octane number higher than that of cat cracked gasoline, and fuels of ratings around 100 F-1 clear will be needed in ever larger quantities.

Processes for the reforming of straight run gasolines over platinum type catalysts and in the presence of hydrogen, such as Houdriforming, can with suitable feed stocks, produce octane numbers of 100 F-1 clear or slightly higher. Conditions required for this type of operation are very severe, however, and require periodic regeneration of the catalyst, offsetting some advantages of simple processes.

The Iso-Plus process produces 100 F-1 clear and higher octane number gasolines from Houdriformates (obtained in continuous, nonregenerative operation) by either of two routes, the economics and technology of which have been discussed in an earlier paper.[1] This article presents process data from commercial and pilot plant operations following one of these routes, namely, thermal reforming of catalytic reformates. This method is relatively simple and particularly attractive to the refiner with idle thermal reforming capacity. It provides an immediate solution for many refiners having to produce very high octane number gasolines.

**Summary of Conclusions:** Consideration of the chemical composition of catalytic reformates indicates that the high

## *with 'Iso-Plus' Catalytic Reforming*

**TABLE 2**—Using 89 F-1 Clear Catalytic Reformate from 260-385 F East Texas Naphtha

| Run number | 8 | | 9 | | 10 | | 11 | | 12 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Soaking Factor[1] | 3.0 | | 5.2 | | 6.0 | | 7.8 | | 9.4 | |
| Yields | wt.% | vol.% | wt.% | vol.% | wt.% | vol.% | wt.% | vol.% | wt.% | vol.% |
| $C_5$+ reformate | 91.6 | 90.2 | 87.7 | 86.5 | 85.3 | 83.6 | 83.1 | 81.4 | 81.0 | 78.6 |
| Tar | 2.0 | 1.6 | 2.7 | 2.2 | 2.9 | 2.4 | 3.2 | 2.6 | 3.9 | 3.2 |
| Dry gas, $C_4$ and lighter | 4.2 | — | 6.3 | — | 7.7 | — | 9.2 | — | 10.1 | — |
| Pentenes | 1.4 | 1.8 | 1.7 | 2.1 | 2.4 | 3.0 | 2.0 | 2.5 | 2.5 | 3.1 |
| Pentanes | 2.4 | 3.1 | 3.0 | 3.9 | 2.6 | 3.4 | 2.9 | 3.8 | 2.1 | 2.7 |
| Butenes | 1.1 | 1.5 | 2.2 | 2.9 | 2.5 | 3.3 | 2.8 | 3.7 | 3.1 | 4.1 |
| Butanes | 1.1 | 1.5 | 1.1 | 1.6 | 1.6 | 2.3 | 1.7 | 2.4 | 1.9 | 2.7 |
| Propene | 1.2 | — | 1.5 | — | 1.8 | — | 2.3 | — | 2.5 | — |
| Potential catalytic polymer (calc.)[2] | 1.7 | 1.9 | 2.9 | 3.2 | 3.3 | 3.6 | 4.0 | 4.4 | 4.3 | 4.7 |

| Inspections | $C_5$+ | Heavy Polymer | $C_5$+ | Heavy Polymer | $C_5$+ | Heavy Polymer | $C_5$+ | Heavy Polymer | $C_5$+ | Heavy Polymer |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity, °API | 41.4 | 11.1 | 41.2 | 11.5 | 40.6 | 11.7 | 39.9 | 9.4 | 39.2 | 9.6 |
| Distillation, ASTM, °F. | | | | | | | | | | |
| IBP | 136 | — | 130 | — | 124 | — | 128 | 436 | 134 | 492 |
| 10% | 216 | — | 208 | — | 206 | — | 202 | 514 | 208 | 520 |
| 50% | 292 | — | 290 | — | 294 | — | 291 | 579 | 296 | 587 |
| 90% | 354 | — | 354 | — | 356 | — | 359 | 688 | 364 | 700 |
| EP | 408 | — | 410 | — | 418 | — | 416 | — | 420 | — |
| RVP | 3.2 | — | 3.8 | — | 2.9 | — | 3.6 | — | 3.2 | — |
| Octanes | | | | | | | | | | |
| F-1 clear of $C_5$+ | 95.9 | — | 97.6 | — | 98.2 | — | 99.7 | — | 100.0 | — |
| F-1 clear of $C_5$+ and catalytic polymer (calc.) | 96.1 | — | 97.9 | — | 98.5 | — | 100.0 | — | 100.3 | — |
| Composition of heavy polymer free $C_5$+ reformate | | | | | | | | | | |
| Paraffin, vol.% | 24.1 | — | 22.5 | — | 19.9 | — | 15.1 | — | 13.1 | — |
| Olefin, vol.% | 3.2 | — | 3.9 | — | 4.2 | — | 4.6 | — | 4.5 | — |
| Naphthene, vol.% | 3.1 | — | 2.9 | — | 2.3 | — | 2.6 | — | 1.9 | — |
| Aromatics | | | | | | | | | | |
| Alkyl + benzene, vol.% | 67.7 | — | 68.4 | — | 71.2 | — | 74.3 | — | 77.4 | — |
| Alkenyl, vol.% | 1.9 | — | 2.3 | — | 2.4 | — | 3.4 | — | 3.1 | — |

(1) Soaking factor is coil volume times reaction rate relative to 800°F. divided by the oil charge rate and has units of $ft.^3$/bpd.
(2) Assumes 95% recovery of butenes, 75% recovery of propene and 90% conversion to polymer.

# via the Thermal Reforming Route

octane components should be stable to thermal reforming and that additional octane gains should be realized by the thermal conversion of low octane number, high molecular weight paraffins in the reformate to liquid and gaseous low molecular weight paraffins and olefins. Pilot plant and commercial demonstrations have confirmed these indications.

Pilot plant results demonstrate that good yield-octane relationships can be obtained when thermally reforming catalytic reformates to octane ratings at least 10 to 14 F-1 clear numbers higher than the catalytic reformate. Thus, good yields of 100 F-1 clear octane rating reformate can be obtained in a continuous reforming operation from those virgin naphthas that can be catalytically reformed to 85 to 90 F-1 clear in a continuous non-regenerative catalytic reforming unit.

Data obtained on a commercial unit agree with the pilot unit data and demonstrate that gasolines of high octane number and desirable stability characteristics are obtainable in excellent yields from the thermal reforming of catalytic reformates.

**The story in three parts:**

1. ***Pilot plant results***
   **show good yield-octane relationship (next page)**
2. ***Commercial operation yields***
   **are excellent for high octanes (pp. 1574-75)**
3. ***Process chemistry data***
   **rounds out 'Iso-Plus' story (pp. 1576-77)**

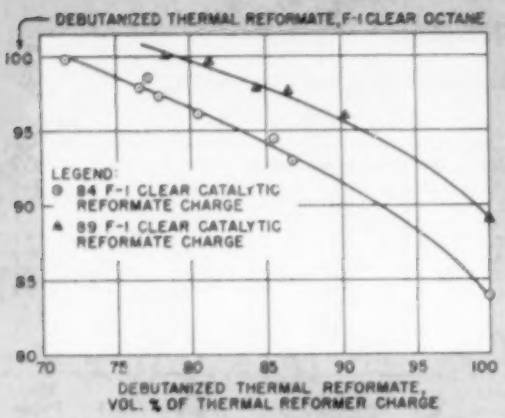



FIG. 1 – Yield octane relationship for thermally reformed Houdriformates from 260-385° F. (ASTM) East Texas naphtha.

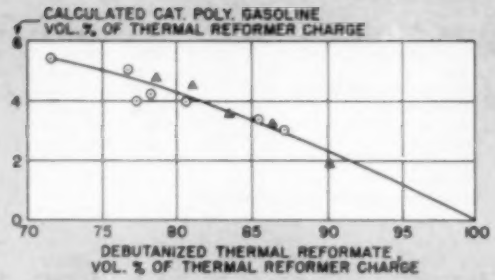



FIG. 2 – Potential catalytic polymer gasoline from unsaturated hydrocarbon gases from thermal reforming of Houdriformate – see Fig. 1.

**Pilot plant yield-octane and production data**

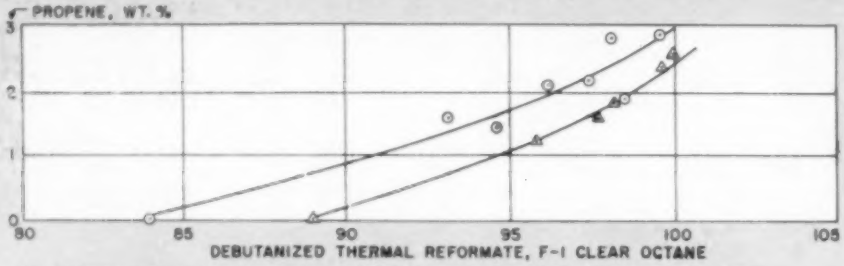



FIG. 3 – Propene produced during thermal reforming of Houdriformate from 260-385° F. (ASTM) East Texas naphtha.

1

## Pilot plant results show good yield-octane

The Iso-Plus processing scheme involving thermal reforming of catalytic reformates has been the subject of extensive pilot plant studies. Typical results obtained when thermally reforming Houdriformates of 84 and 89 F-1 clear octane rating derived from East Texas type naphtha (260-385° F. ASTM) are presented in the following paragraphs. These results were obtained in a pilot plant with a maximum charge capacity of approximately 1 barrel per day.

Data presented in this paper concern the thermal reforming of full boiling range catalytic reformates only. Interesting modifications of this process result from the thermal reforming of selected cuts of catalytic reformates. These will be reported in a subsequent article in PETROLEUM PROCESSING.

Results from the thermal reforming of an 84 F-1 clear octane Houdriformate in 7 pilot plant runs are presented in Table 1 and from the thermal reforming of an 89 F-1 clear octane Houdriformate in 5 pilot plant runs in Table 2.

The thermal reforming pilot plant operations were carried out at pressures between 400 and 750 psig and temperatures between 950 and 1025° F. The extent of reforming was adjusted by proper choice of the pressure and temperature variables, the oil charge rate, and the reformer coil volume. Within the ranges used, no significant effect of operating variables on the yield of heavy polymer at a given thermal reformate octane rating was ever noted.

The F-1 clear octane rating of the debutanized thermal reformate is shown on Fig. 1 as a function of the yield of debutanized reformate based on the charge to thermal reforming. Using 89 F-1 clear octane charge stock, the yield is about 79.5 volume % at an octane rating of 100 F-1 clear. At a given octane rating, the reformate yields from the 84 F-1 clear octane Houdriformate charge are from 5 to 8 volume % of charge lower than those from the 89 octane material.

The calculated potential gasoline yield from catalytic polymerization of the $C_3$ and $C_4$ unsaturates is shown on Fig. 2 as a function of the yield of debutanized thermal reformate. The potential catalytic polymer yield increases to 5.5 volume % of the thermal reformer charge as the debutanized thermal reformate yield decreases to 72 volume %.

The catalytic polymer yields from thermal reforming the 84 and 89 octane reformates are the same. Thus, the yield of polymer gasoline tends to compensate for the yield decrease which occurs as thermal reforming severity is increased.

The catalytic polymer gasoline yields were calculated assuming a 95% recovery of butenes, 75% recovery of propene, and 90% conversion to polymer. The propene and butene yields are presented on Figs. 3 and 4 as a func-

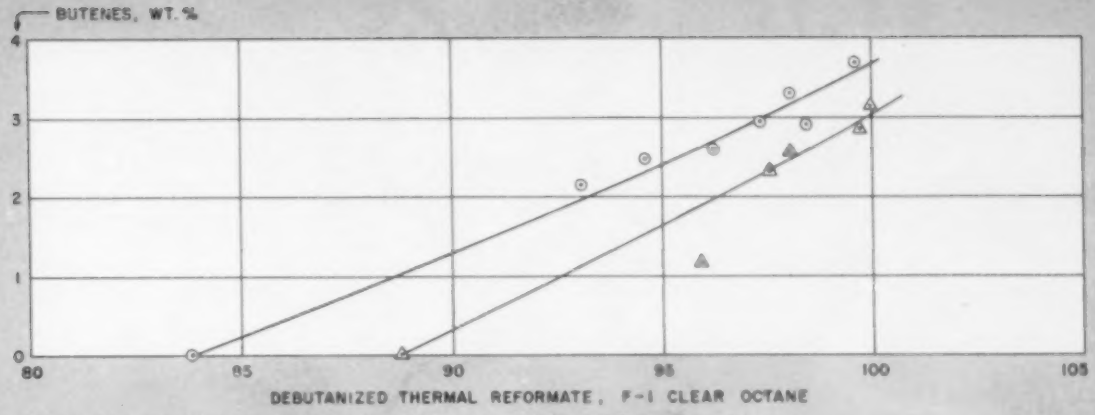



FIG. 4 – Butenes produced during thermal reforming of Houdriformate from 260-385 F. (ASTM) East Texas naphtha.

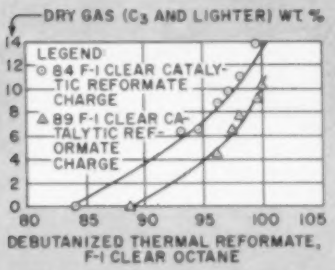



FIG. 5 – Dry gas produced during thermal reforming of Houdriformate from 260-385 F. (ASTM) East Texas naphtha.

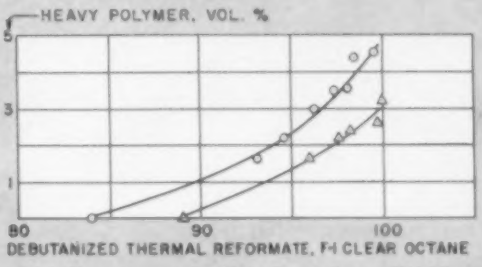



FIG. 6 – Heavy polymer produced during thermal reforming of Houdriformate from 260-385 F. (ASTM) East Texas naphtha.

## relationship

tion of the octane rating of the thermal reformate. As would be expected, the yields of propene and butene are higher at a given product octane rating for the lower octane charge material.

Yields of dry gas and heavy polymer also are shown as a function of product octane on Figs. 5 and 6. For a given product octane rating both dry gas and heavy polymer yields from thermally reforming the 84 octane Houdriformate are higher than those from thermally reforming the 89 octane Houdriformate.

Fig. 7 presents the over-all yield-octane relationship for Houdriforming plus thermal reforming including catalytic polymer gasoline. Yields are expressed on the basis of the naphtha charge to Houdriforming.

Thermal reforming after catalytic reforming to 84 and 89 F-1 clear levels produces 100 F-1 clear gasoline at over-all $C_5$ + yields of about 68 and 73 volume %, respectively. The corresponding yields of 10 RVP gasoline are 75% and 81%.

This clearly demonstrates the advantage of catalytic reforming to as high a level as practicable consistent with long catalyst life. The curves in Fig. 7 indicate that good yield-octane relationships can be obtained when thermally reforming catalytic reformates to octane ratings of at least 10 to 14 F-1 clear numbers higher than the catalytic reformate.

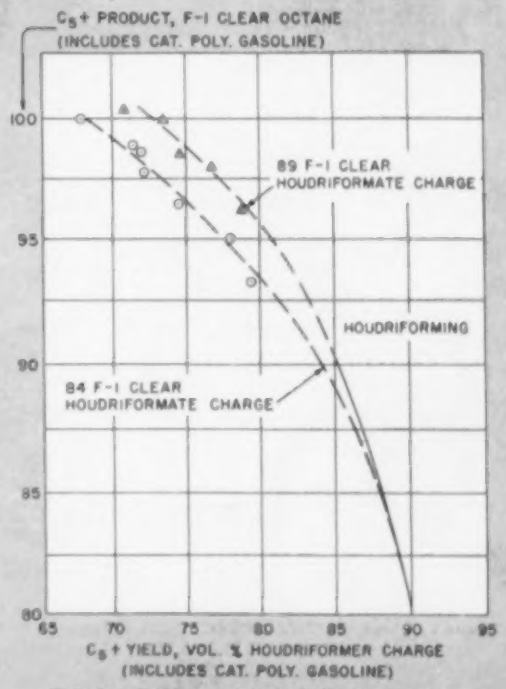
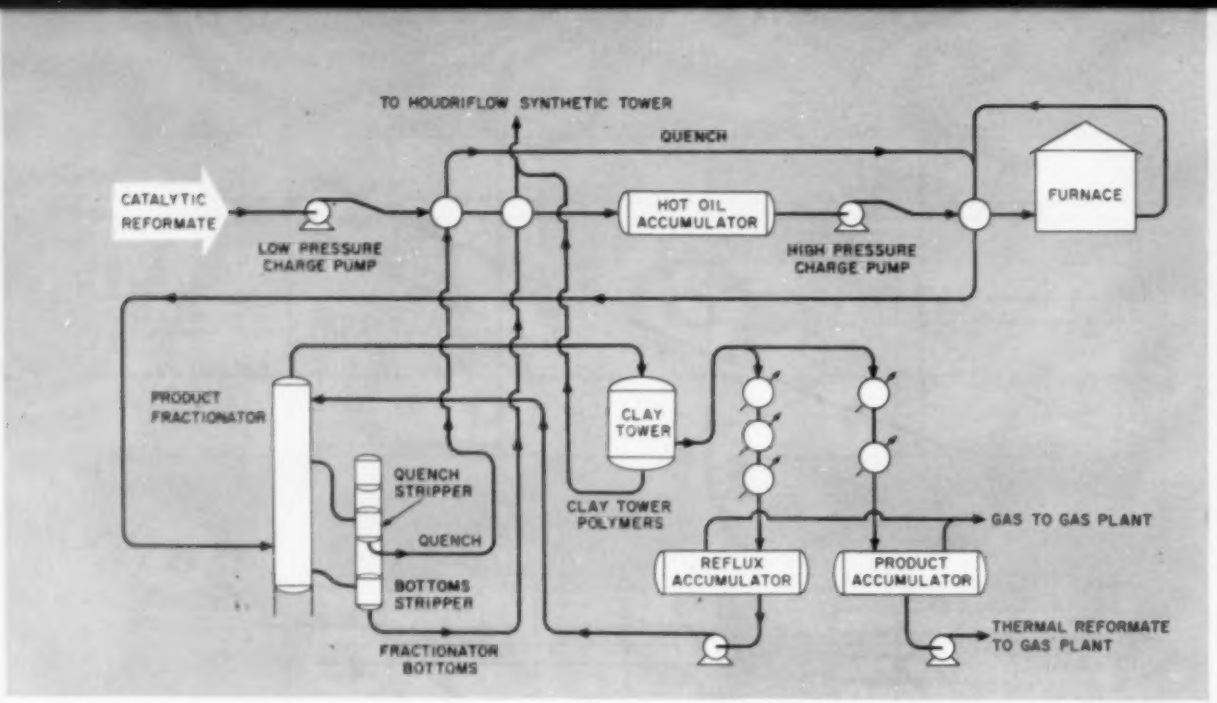



FIG. 7 – Over-all yield-octane relationship for Houdriforming plus thermal reforming, including catalytic polymer gasoline.

***Please turn page for commercial operation results***




**COMMERCIAL THERMAL REFORMER** flow diagram for the thermal reforming of catalytic reformate.

## *The Process and How It Works*

Catalytic reformate from storage was pumped through heat exchangers to a hot oil accumulator. Charge to the reformer furnace was pumped from the hot accumulator through an effluent-charge heat exchanger by a high pressure charge pump. Furnace effluent was quenched, cooled by charge stock, and charged to the bottom of the product fractionator.

Fractionator bottoms were stripped with steam and sent to the synthetic tower of a Houdriflow catalytic cracking unit for gasoline recovery. A sidestream was drawn from the thermal reformer fractionating tower, cooled, and used to quench the furnace outlet. No quench was taken as product during this study.

The thermally reformed gasoline was taken overhead and charged to a clay tower. Polymers from the clay tower were sent to the Houdriflow synthetic tower in mixture with the fractionator bottoms. Clay tower effluent was split into reflux and product streams, and the two streams were cooled and condensed for separation before charging.

Uncondensed gases from the product and reflux separators and the reformate product were charged to the refinery gas plant for light hydrocarbon recovery. Propene and butenes were charged to catalytic polymerization. Butanes and unconverted butenes were used for gasoline vapor pressure blending.

## Commercial operation yields are excellent

Pilot plant results have been confirmed by commercial operation of this processing scheme. The following material presents data from a 5000 b/d thermal reformer—shown in the flow diagram—and compares them with pilot plant data.

The results of three commercial surveys are presented in Table 3. An 80.5 F-1 clear catalytic reformate was thermally reformed at temperatures of approximately 980, 990 and 1000° F. to produce reformates having F-1 clear octane numbers of 90.0, 93.4 and 95.2, respectively.

The depth of thermal reforming, expressed as weight per cent yield of dry gas, varied from 4 to 10. The severity defined by the soaking factor, varied from 3.5 to 5.7. Operating experience since these data were obtained has confirmed that runs of normal duration on the thermal unit will be obtained from this type of operation.

The commercial data on the gasoline plus catalytic polymer show slightly higher yields at a given octane number than the corresponding pilot unit data. Fig. 8 is a plot of the F-1 clear octane number of the product versus the

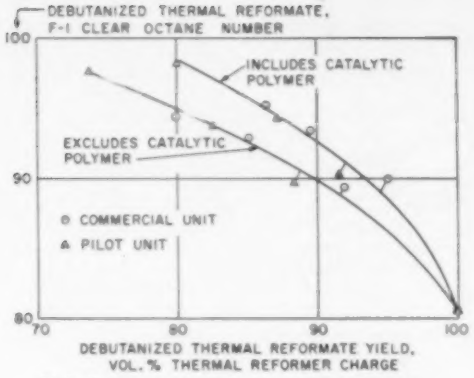



FIG. 8—Yield-octane relationship for debutanized thermal reformate.

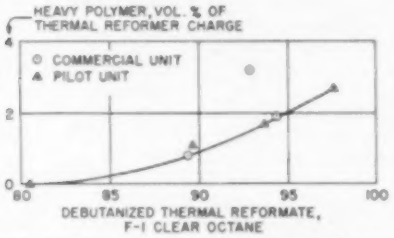



FIG. 9—Comparison of pilot plant and commercial tests for heavy polymer production during thermal reforming of Houdriformate.

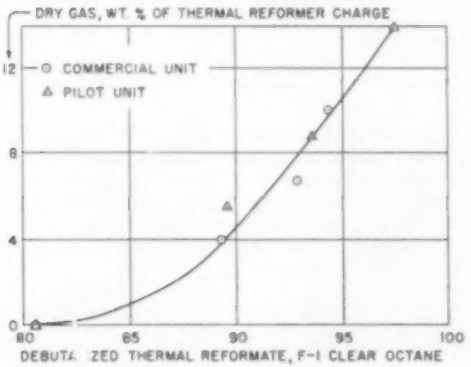



FIG. 10—Comparison of pilot plant and commercial tests for dry gas production during thermal reforming of Houdriformate.

**Table 3—Commercial thermal reforming of various catalytic reformates**

| Survey number | 1 | | 2 | | 3 | |
|---|---|---|---|---|---|---|
| Plant operating data | | | | | | |
| Charge rate, b/d | 5,616 | | 5,611 | | 5,700 | |
| Charge octane number | | | | | | |
| F-1 clear | 80.9 | | 80.4 | | 80.2 | |
| F-1 at 3 cc TEL/gal. | 92.9 | | 92.4 | | 92.4 | |
| Product (—440°F.) | | | | | | |
| Yield, vol.% | 92.0 | | 85.2 | | 80.0 | |
| F-1 clear octane | 89.4 | | 92.9 | | 94.4 | |
| Total potential debutanized gasoline | | | | | | |
| Yield[1] | 95.1 | | 89.6 | | 86.4 | |
| F-1 clear octane[2] | 90.0 | | 93.4 | | 95.2 | |
| Depth of thermal reforming | | | | | | |
| wt.% $C_4$ and lighter | 3.9 | | 6.7 | | 10.1 | |
| Soaking factor relative to 800°F., CF/bpd | 3.5 | | 4.2 | | 5.7 | |
| Heater outlet temperature, °F. | 982 | | 992 | | 1000 | |
| Heater inlet pressure, psig. | 760 | | 795 | | 850 | |
| Heater outlet pressure, psig. | 540 | | 575 | | 615 | |
| Product yields | vol.% | wt.% | vol.% | wt.% | vol.% | wt.% |
| Dry gas, $C_3$ and lighter | | 3.9 | | 6.7 | | 10.1 |
| Butanes | 4.4 | 3.3 | 6.3 | 4.8 | 8.7 | 6.6 |
| $C_5$ to 440°F. gasoline | 92.0 | 90.0 | 85.2 | 84.5 | 80.0 | 80.9 |
| 440°F. to EP heavy polymer | 0.8 | 0.8 | 3.2 | 4.0 | 1.9 | 2.4 |
| Light hydrocarbon breakdown | | | | | | |
| Methane and hydrogen | | 0.4 | | 1.1 | | 1.4 |
| Ethylene | | 0.2 | | 0.5 | | 0.7 |
| Ethane | | 0.6 | | 1.4 | | 2.1 |
| Total $C_3$ and lighter | | 1.2 | | 3.0 | | 4.2 |
| Propylene | 1.9 | 1.3 | 2.8 | 1.9 | 4.0 | 2.7 |
| Propane | 2.2 | 1.4 | 2.8 | 1.8 | 5.0 | 3.2 |
| Isobutane | 0.5 | 0.3 | 0.5 | 0.4 | 0.5 | 0.3 |
| Isobutylene | 1.4 | 1.1 | 1.9 | 1.4 | 2.9 | 1.8 |
| Normal butylene | 1.7 | 1.3 | 2.4 | 1.9 | 3.9 | 3.1 |
| Normal butane | 0.8 | 0.6 | 1.5 | 1.1 | 1.9 | 1.4 |

(1) Includes catalytic polymer from propylenes assuming 75% recovery and 90% conversion, plus catalytic polymer from butylenes at 95% recovery and 90% conversion.
(2) Calculated assuming catalytic polymer F-1 clear blending octane number = 105.

volume per cent $C_5$ + yield obtained. The gasoline yields and octane ratings are plotted both with and without the calculated catalytic polymer from the polymerization of the propene and butenes produced. Similar pilot unit data on the same charge stock are plotted for comparison.

The yield-octane relationship obtained when catalytic polymer is included in the product is excellent for these high octane levels. Moreover, the stability of these clay-treated thermal reformates as expressed by copper dish and ASTM gums, is very good. The copper dish gums ranged from 3 at the lowest severity of thermal reforming to 15 at the highest severity. The ASTM gums ranged from 0.2 to 0.8.

Dry gas and heavy polymer yields as a function of thermal reformate F-1 clear octane number are shown in Figs. 9 and 10. The pilot unit data for the same charge stock are again shown for comparison. The agreement between commercial and laboratory data is again excellent. The heavy polymer yield from one commercial run deviates widely from the remainder of the commercial and pilot unit data. Difficulty was experienced with control of the fractionator bottoms flow in this run, and the experimental determination of heavy polymer yield was known to be of doubtful validity.

This method may be particularly advantageous for the refiner with idle thermal reforming capacity. The operating severities required and the run lengths obtained, in both the catalytic and thermal steps, are in the normal commercial range.

***Please turn page for process chemistry data***

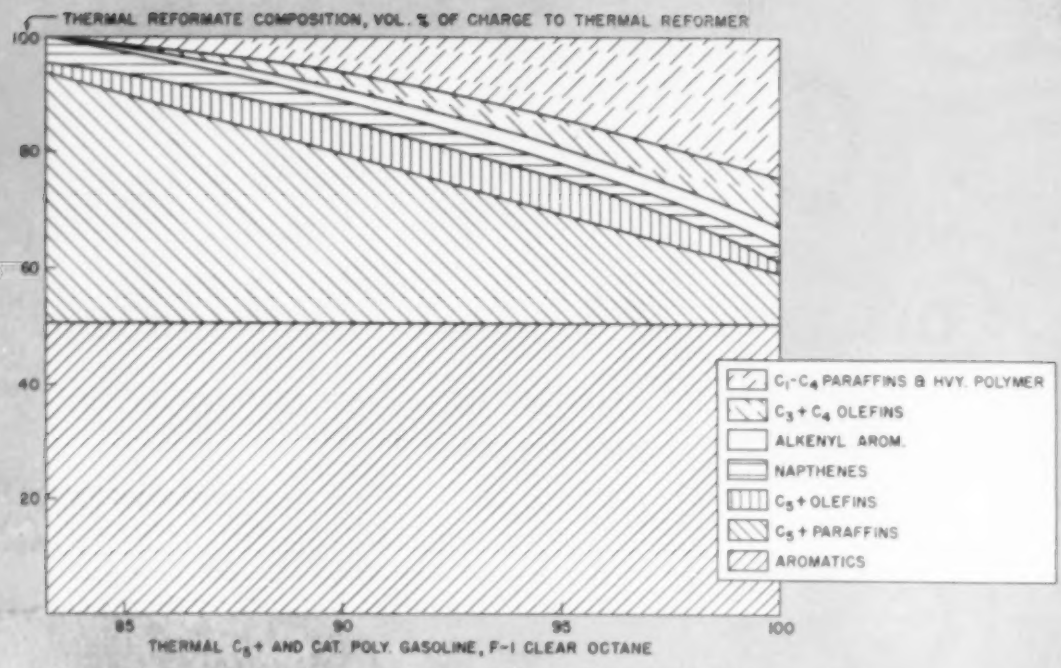



FIG. 11 – Thermal reformate composition-octane relationship when reforming an 84 F-1 clear octane Houdriformate.

# 3 Chemical process data

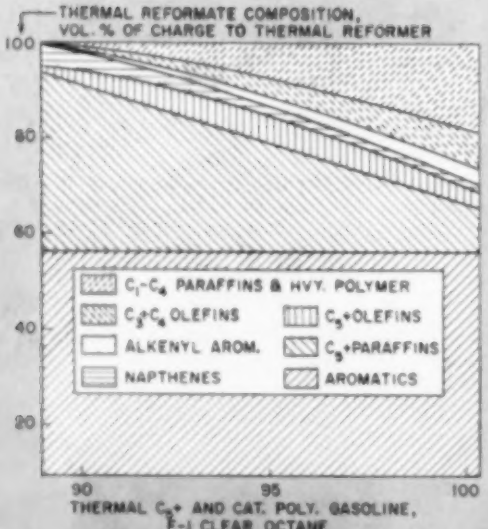



FIG. 12 – Thermal reformate composition-octane relationship when reforming an 89 F-1 clear octane Houdriformate.

The chemical reactions leading to the formation of high octane number components in catalytic reforming have been discussed before.[2] A very major octane boost is obtained by the conversion of $C_7$-$C_{10}$ naphthenes, both of the cyclohexane and methylcyclopentane types, to aromatics by dehydrogenation and dehydroisomerization. An aromatic product fraction of about 120 F-1 blending value is obtained.

Paraffin isomerization, which proceeds during Houdriforming to thermodynamic equilibrium, boosts the over-all octane number of the Houdriformate but cannot by itself give very high octane numbers. This is apparent from the F-1 octane numbers of the equilibrium mixture of isomers in Houdriformate at 950° F. for different paraffins:

| | |
|---|---|
| Butanes | 92 |
| Pentanes | 82 |
| Hexanes | 68 |
| Heptanes | 57 |
| Octanes | 37 |

Aromatization of paraffins by dehydrocyclization is a source of very high octane number hydrocarbons, but this reaction proceeds best at low pressures, at which catalyst deactivation occurs and, therefore, periodic catalyst regeneration is required.

Catalytic cracking of paraffins to lower molecular weight paraffins occurs during Houdriforming as an octane number boosting reaction, but has to be carefully controlled to obtain long catalytic life.

Since naphthene to aromatic conversion and paraffin isomerization are fully utilized in Houdriforming at relatively mild conditions, the only remaining reaction available for the further upgrading of Houdriformates are other reactions involving paraffins.

Conversion of low octane number paraffins by cracking

to low molecular weight high octane paraffins and gas and by cracking to olefins appears attractive. This can be accomplished by thermal cracking of the total reformate or of fractions thereof.

Another possibility is the selective separation of paraffins from the reformate and catalytic upgrading of this fraction by dehydrocyclization and selective cracking.

During the thermal reforming of catalytic reformates, there is essentially no destruction of aromatics. Houdriformates of 84 F-1 clear and 89 F-1 clear from the same virgin naphtha and containing 50 and 55% aromatics, respectively, were thermally reformed. In both cases all the aromatics in the charge were recovered in the products at all levels of thermal reforming severity. This is shown in Figs. 11 and 12, in which the volume per cent aromatics based on feed to the thermal reformer is plotted as a function of octane numbers.

When charging the 84 F-1 clear reformate, containing 44.2% paraffins, 1.7% olefins, 49.5% aromatics and 4.6% naphthenes (4.1% alkylcyclopentanes), octane number gain at increasing severity is due to the selective thermal cracking of paraffins to lower molecular weight liquid and gaseous paraffins and olefins (Fig. 11).

The amount of $C_5$ + olefins produced is fairly constant at all severities investigated. There is an indication that at the most severe conditions the amount of $C_5$ + olefins begins to decrease.

The production of $C_3$ and $C_4$ olefins, suitable for catalytic polymerization, increases with increasing severity.

A new product appearing in the thermal reformate which is not present in the Houdriformate charge consists of alkenyl aromatics. The amount of these aromatics, with unsaturated side chains, produced corresponds quite closely to the disappearance of naphthenes as shown by pilot plant data (Fig. 11).

The clay treated gasolines produced commercially by thermally reforming catalytic reformates contained 1.4 to 2.4 volume per cent $C_9$ to $C_{11}$ alkenyl aromatics and possessed excellent stability characteristics. Since all naphthenes in the feed are alkylcyclopentanes or dicyclic naphthenes, it is probable that these have been converted to alkenyl aromatics by dehydrogenation or dehydroisomerization. This conversion greatly improves octane number.

The picture is quite similar for the thermal reforming of an 89 F-1 Houdriformate containing 39.6% paraffins, 1.9% olefins, 55.1% aromatics and 3.4% naphthenes (2.5% alkylcyclopentanes and 0.9% dicyclic naphthenes). Changes in product composition are shown in Fig. 12.

Although the paraffin content of the 89 F-1 clear reformate is 6% lower than that of the 84 F-1, the paraffin content of the thermally reformed product from the former is higher at any given octane level, than that of the 84 F-1 reformate. At 100 F-1 clear for example, the paraffin content of the thermal product from the 89 F-1 Houdriformate is 15.1 vol. % (based on product) or 11.3% (based on charge), while that from the 84 F-1 Houdriformate is 12.2 vol. % (based on product) and 8.1% (based on charge).

The $C_3$ + olefin content, on the other hand, is lower in the product from the thermal reforming of the higher octane number Houdriformate. Alkenyl aromatics are again formed and accounted for by loss in naphthenes.

(1) Noll, Schall, Craig, and Stevenson, *Oil & Gas Journal*, March 28, 1955.
(2) Heinemann, Mills, Hattman, and Kirsch, *Industrial and Engineering Chemistry*, 45, 130-134 (1953).

## Meet the Authors

Dr. Heinemann

Mr. Maerker

Mr. Walser

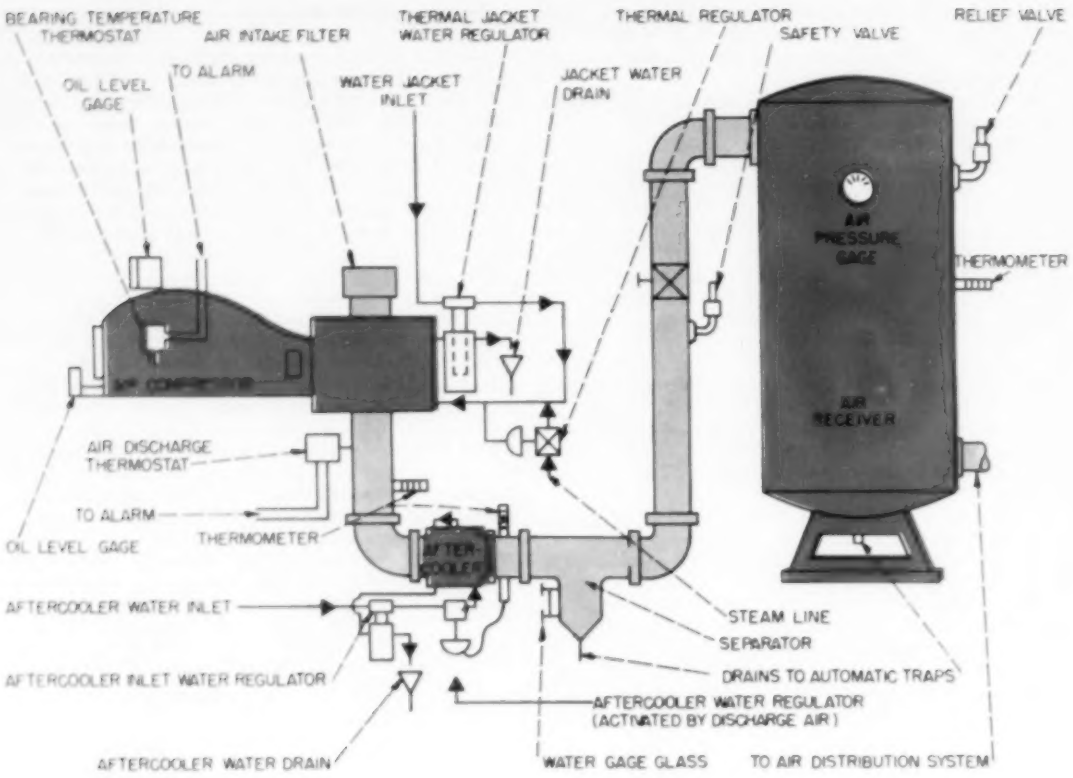
Dr. Kirsch

Heinz Heinemann is Section Chief in charge of Process Research at Houdry Process Corp. Born in Berlin, Germany, in 1913, he received a Ph.D. degree from the University of Basle, Switzerland. The author of numerous publications and patents on catalytic and petroleum chemistry, he worked for several petroleum companies and catalyst manufacturers before coming to Houdry in 1948. In 1941 he taught at Carnegie Institute of Technology. A member of ACS, AAS and various foreign scientific groups, Dr. Heinemann is currently Executive Secretary for the forthcoming International Congress on Catalysis. He is a past chairman of the Catalysis Club of Philadelphia.

J. B. Maerker was born in Jackson, Michigan in 1920. He received his B.S. in Chemical Engineering in 1943 from the University of Tennessee. At that time he joined the Houdry Process Corp. as Development Engineer and is currently serving as Section Chief of the Commercial Development Section. Mr. Maerker is a licensed professional engineer and an active member of the AIChE.

Frederick R. Walser was born June 19, 1921 in Syracuse, New York. He attended Cornell University where he received his B.S. degree in Chemical Engineering in 1944. He joined Houdry in 1952 as a Development Engineer and is currently assigned to the Commercial Development Section. Prior to this, he worked as a Chemical Engineer at the Atlantic Refining Co. from 1944 to 1952. Mr. Walser is a member of the AIChE.

F. W. Kirsch has done catalytic process research at Houdry since 1950, when he completed requirements for a Ph.D. in physical chemistry at the University of Pennsylvania. Previously he had received Bachelor's and Master's degrees in Chemical Engineering at the University of Delaware. He held a Pratt and Whitney research fellowship in combustion and fluid flow at Delaware. While at Pennsylvania he also taught analytical chemistry. His honorary societies include Pi Mu Epsilon (mathematics) and Phi Kappa Phi. Currently he is a member of ACS, AIChE, and the Catalysis Club of Philadelphia.




*Proper Accessories Can Insure*

# A Dependable Air Supply

## *Would any of these accessories improve your air supply?*

- **intake air filter**
- **filter hood**
- **aftercooler separator**
- **automatic moisture trap**
- **relief valve**
- **safety valve**
- **shut-down control**
- **overspeed trip**
- **oil pressure failure device**
- **recording instruments**
- **thermometers**
- **aftercooler water regulator**
- **noise alarm**
- **safety device checker**
- **steam valve**
- **water regulating valve**
- **outlet water throttling valve**

***By R. A. Schaefer***
***Worthington Corporation***

WHEN did you last look at your compressed air unit? Chances are its performance could be improved and its maintenance costs lowered. The accessories at the left can do that job. The drawing above shows you where they fit in.

Few set-ups need all the devices. But each of these accessories fills an important function. You should consider their application to your compressed air system. If any of them can be applied you are almost sure to profit. Most of these attachments have been available for some time and have a long history of successful application.

## Filtering at the Intake

**Air filters** should be must equipment on all air compressors. Open suction piping is a sure and fast road to costly damage and expensive down time. Dirt, grit, and insects swept into a cylinder will not only clog valves and rings, but will abrade moving parts as well. A blueprint and several rags were found in the valves of one compressor with wide open intake.

Yet good filters are available for almost any job at reasonable cost. Viscous impingement types will do for average conditions. For heavily laden air use of oil bath units is recommended. In non-lubricated carbon ring compressors, where the air must be kept free from oils of any kind, you can use a dry-type filter with felt and wire mesh elements.

**Air intake louvers or hoods** placed before the filter will keep snow and rain out of the intake. This opening should be placed where the air is least contaminated — never near steam exhausts or paint spraying areas. Brace the intake flue with extra supports to avoid undue strain on the cylinder from which it hangs.

For best efficiency draw your air from as cool a source as possible. Each 5° F. change in the suction temperature affects the volumetric efficiency of the compressor by about 1%.

## Cooling

An air compressor operates best with the water jacket lukewarm to the touch, at about 105° F. At that temperature you get a minimum of condensation when the hot air hits the cooler jacket. This means less chance of valve erosion or premature wear of piston rings. But watch out for too great a temperature difference in inlet and outlet water. Extremely cold inlet water will set up dangerous stresses and cause warpage of the air cylinder, even if outlet temperature is normal. Follow these rules:

1. Keep cooling water temperature 15 to 20° F. above that of the incoming air.
2. Maintain about a 30° F. difference in the inlet and outlet water.
3. Keep outlet water below 140° F.
4. Remember: too high a temperature affects proper lubrication.

**A steam valve,** thermally activated, can be used to raise the temperature of inlet water. As hooked up in the diagram on the facing page the steam valve will release a small jet of steam for input to the system in quantities determined by the temperature of the incoming water.

**Aftercoolers** are among the best ways to keep moisture out of compressed air distribution systems. These units remove moisture before the air enters the distribution system.

For example, 1000 cu. ft. of saturated air at atmospheric pressure and 80° F. contains 1.58 lbs. of moisture. If this air is compressed to 100 psig. and then cooled in an aftercooler to 80° F., the moisture content will be only 0.195 lbs. The difference of 1.385 lbs. is separated and drained out by the aftercooler.

You can choose an aftercooler from a variety of shapes and sizes. They range from tube-and-shell type, in either vertical or horizontal position, to the box like tank-and-air type with cooling water open to atmospheric pressure. The pipeline type is popular because it can be installed as part of the air distribution line.

## Moisture Removal

You should start thinking about moisture removal right at the air compressor. It is common knowledge that moisture in the system can cause early tool wear and breakdown. Its less widely known that moisture causes trouble at the compressor, too. Among its damaging effects are premature cylinder wear and dilution of lube oil.

**An automatic moisture trap** is recommended to drain the aftercooler condensate mentioned above, preserving the efficiency of the separator for its job of keeping moisture out of the distribution system.

**A separator** directly ahead of the cylinder suction port will intercept moisture destined for the compressor itself. This can also be done by inclining the air inlet piping toward the cylinder and installing a drop leg. The air discharge line should slope away from the air compressor outlet.

In general, efficient moisture removal depends on proper slope of pipes and generous use of traps and separators, or "knockout drums."

## Water Regulators

**The water regulating valve,** one of the most useful controls, is often overlooked because its full value is not realized. Take a typical 500-cfm. compressor operating six hours a day, of which three are in unloaded state. With a regulating valve you can save hundreds of gallons of water by closing off the jacket water supply during periods when the plant is idle.

The water-regulating valve, either diaphragm or solenoid operated, can be wired so as to operate only on shut-down and starting of the compressor. Or you can adjust it to throttle down the supply during the unloaded state, when only friction heat needs to be removed. Where electricity is not available, the valve can be activated by air bled from the unloaders, and vented back through these same lines upon resumption of load.

**The throttling valve** actuated by the temperature changes in the outlet water is another device to aid in efficient operation and water conservation. The detecting element is inserted in the water outlet piping, as shown in the diagram. The valve is installed in the inlet water line. An increase or decrease in outlet water temperature increases or decreases the valve opening.

Not enough cooling water can be as bad as too much cold water. It permits the temperature of the discharge air to go too high. Then the viscosity of the lubricating oil changes or breaks down, leading to prematurely worn parts. So why rely on undependable manual adjustment when you can install automatic regulators at reasonable cost?

## Protective Devices

Whether your compressor set-up is of the central-station or multi-area type, you can profit by the use of many simple mechanical controls and protective devices.

**Relief valve.** Every system needs a relief valve on the air receiver and compressor intercooler (if more than single-stage) to guard against damage from high pressures. Have you got one? Is it working? Might be a good idea to test it and see.

**Safety valve.** A safety valve (usually of the spring-loaded type) should be installed in the line between the compressor and the shut-off valve leading to the air receiver. Be sure its capacity is enough to handle the compressor capacity.

Cutting costs by undersizing this valve doesn't pay. If you're lucky, you might get off with blown motor fuses during an overload. But it could cost you a cracked compressor cylinder.

**Thermostatic shut-down controls** for detection of high temperature in bearings and discharge air can prevent serious trouble. In these controls an excessive rise in temperature at the point being guarded will break an electrical contact, open the starter circuit, and thus stop the motor.

In one installation the heat of the discharge air had risen to a point where the operator had about decided

### *The Air Receiver and How to Select It*

There are tanks and bigger tanks for any job. But what is the right size? As you will see later in a formula, the proper selection of one or more tanks is based not only on the capacity of the compressor itself, but also on the shop load cycle.

The receiver, whose important functions, incidentally, we often lose sight of, acts primarily as a pulsation damper and warehouse for air. But it is also a condensate collector. Moisture and oil drop to the tank bottom because of the decreased air velocities in the tank. So it is wise to use automatic moisture traps to pass off the condensate. If you do not drain the tank regularly, you cut its capacity.

In many installations, it pays to install one or more extra receivers farther on in the system. By installing a tank in a long distribution line, or at a point of intermittent heavy demand, you obtain a system that can cope with maximum load periods. Also you minimize the chances of excessive pressure drop during heavy loads.

Be careful, then, in ordering that extra compressor you think you need for those heavy load periods.

Before you buy, make a rough check on your storage capacity by using the following formula. You may find that an extra receiver is all you need:

$$V = \frac{T \times (P_1 - P_2)}{C \times P_a}$$

Where T = time in minutes receiver will supply air from upper to lower pressure limits.

V = volume of tank, in cu. ft.

$P_a$ = absolute atmospheric pressure, psia.

$P_1$ = maximum tank pressure, absolute (compressor discharge pressure).

$P_2$ = minimum tank pressure, absolute (pressure required to operate tool).

C = cu. ft. of free air needed per minute (from study of load cycle).

he needed a larger aftercooler. In checking the unit the service engineer found the oil feed had run dry. Piston, cylinder, and rings were all badly scored, and required expensive repair. A thermostatic watchman in the discharge line would have prevented this.

Normally such bearing temperature protection is used only on larger compressors. But you would be wise to consider it for smaller machines, particularly if the operation is round-the-clock or of a critical nature.

**Overspeed trips.** Steam-driven units need overspeed trips to guard against governor failure. They also need safety stops to shut off the steam supply should the governor chain linkage fail.

In a typical stop guard, a pivoted pulley rides on top of the chain during normal operation. If the linkage breaks, the pulley drops and releases a spring-loaded lever. This in turn forces the governor valve to seat, and closes the steam supply.

Don't overlook the advantages of a relief valve on the steam cylinder to protect it against the dangers of condensate accumulation. It takes only one revolution in a water-clogged cylinder to blow the works.

**Oil-pressure failure device.** On compressors with force-feed lubrication, a shut-down device for oil-pressure failure is becoming standard equipment. If your compressor doesn't have one, you can buy one for about $25. It works the same as a thermostatic control, except that an oil-pressure drop shuts off the motor.

**Recording instruments.** Where compressors are remotely mounted, pressure and temperature recorders are a good investment. They tell you all you need to know about operations and help to diagnose symptoms of trouble.

**Thermometers.** On important installations, you will want to check the operating characteristics such as pressure, temperature, and load. Most installations have a pressure gage on the air receiver, but not a thermometer. A thermometer here will show how well you are using receiver capacity to store air—the hotter the air, the less weight you can store. Should the receiver air drop below 32° F., you'd better make sure condensation can't freeze and crack the drain.

Thermometers in the air line at the compressor air discharge and on the downstream side of the aftercooler also are good check points. Valve leakage and resultant re-compressing of air will jack up discharge temperature. If you exceed, say, the normal range of 350 to 380° F. in a single stage unit, you know there is trouble. In most aftercoolers a downstream air temperature 10 to 15 degrees above inlet water temperature is a good goal. Failing this, your heat transfer is not good. You may need more water, or the tubes are scaled up.

### Optional Devices

There are protective and conservation measures that may boost operating efficiency, but their use is optional. Not many installations would justify their cost.

**Aftercooler water regulator.** Aftercooler water can be controlled by a regulator similar to that of the compressor proper (see diagram). That is, the inlet flow can be regulated by changes in the aftercooler water outlet temperatures. Probably a better arrangement would be to control the inlet water by activation from the discharge air temperature on the downstream side of the aftercooler. A rise in the air temperature would cause the regulator to admit more water into the shell, thereby providing a greater quantity for heat transferring purposes.

In many installations the aftercooler water piping system is in series with the compressor jacket water piping, so that a single regulator can be used for both. Frequently this arrangement will permit elimination of preheating equipment for the jacket water inlet of the compressor. The cooling of the air in the aftercooler will raise the temperature of the outlet water high enough to run it directly to the compressor.

**Noise alarms.** Thermostats used for detection of high temperatures in the air and running gear can also be connected to noise alarm systems.

**Mercury pressure switches** can be used to warn the engineer of excessive pressure drops. At a predetermined low-pressure point the mercury will close the alarm circuit, setting off a noisemaker.

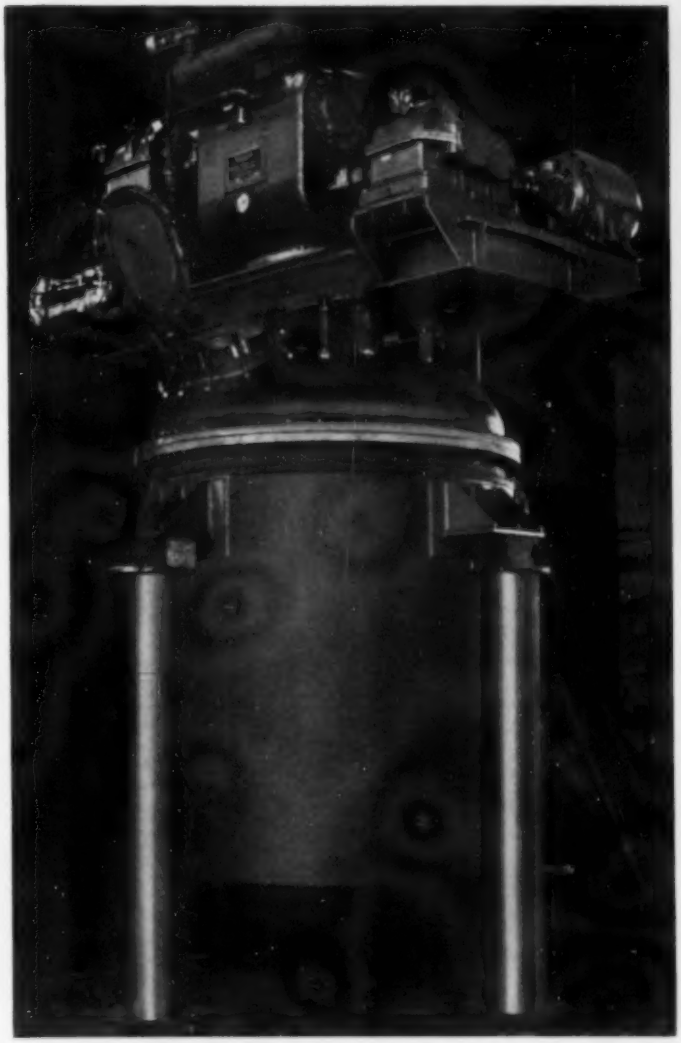
To be ultrasafe, protective devices to monitor other protective devices are sometimes used. It depends upon the state of mind of the particular engineer. While too many safety measures can never be a "bad" thing, they can become expensive if not carefully and selectively chosen.

The preceding is based on information in an article by Mr. Schaefer in *Power and Fluids*, Summer, 1955, Worthington Corp., Harrison, N. J.

# Buflovak Jacketed Grease Kettles are engineered for specific process requirements

...to fit specific processing operation needs

...to provide profitable performance



The kettle illustrated is a Buflovak Jacketed Grease Kettle with a 2500-gal. capacity. It is equipped with a compact 150-hp Cone Gear Drive for operating a Double Motion Agitator, with scrapers, to speed operation. A pneumatic discharge valve saves valuable time. It was designed and engineered by Blaw-Knox engineers to meet the specific requirements of the operation for which it was built.

We can help you solve your kettle problems. Blaw-Knox engineers have had a broad experience in designing and building kettles of every description, from the laboratory—few-gallon, capacity models to ones that process several thousand gallons—not just greases but a large number of varied products. This experience enables our engineers to incorporate in the design of each kettle all the features that are particularly applicable to the operation under consideration. Such features include size of kettle, type of body, agitators, drive, high or low temperature control, method of heating and cooling, heat source, openings and outlets, and so on.

Why not call us and let Blaw-Knox engineers make their recommendations?

**A Complete Process Equipment Service**

Kettles of every description constitute but one phase of Blaw-Knox Process Equipment design, engineering and fabrication service for the chemical, food, pharmaceutical, plastic and resin, petroleum, rubber and other industries: EVAPORATION • DRYING • FLAKING • MIXING • REACTION IMPREGNATING • VULCANIZING • SOLVENT RECOVERY SOLVENT EXTRACTION • CRYSTALLIZATION • DISTILLATION POLYMERIZATION • GAS CLEANING • GAS ABSORPTION • HEAT TRANSFER • VAPORIZATION • CONDENSATION • STERILIZING LOW AND HIGH PRESSURE PROCESSING

**CATALOG NO. 356-R is available on request**

*Everything in Process Equipment*

**BLAW-KNOX COMPANY**
**BUFLOVAK EQUIPMENT DIVISION**
**1641 Fillmore Avenue, Buffalo 11, N. Y.**


*(To obtain more data on advertised products see page 1628)*

**Ethyl research chemist** synthesizes a complex additive molecule—perhaps one that has never been made before.

# No. 399 puts Ethyl Research nearer the answer

At last count our chemists had just developed compound No. 399 in the search for a gasoline additive to combat a specific engine-fuel problem—so today we're just that much closer to a solution of the problem.

It's no secret that "finding" a new additive takes time and imagination. For example, before we developed "Ethyl" Antiknock Compound, several thousand different elements and compounds were tested. And more than 300 compounds were tested before the new "Ethyl" Diesel Improver was perfected.

Usually a petroleum additive depends for its action on a single chemical element or grouping of elements. To find it may take months or even years of research.

The next step—and often the most difficult—is to discover the best chemical structure to contain the element. How can its atoms be arranged so that it will act at just the right time and place? Many new compounds (some of which have never been made in any laboratory) may have to be synthesized before the right one is found. This calls for the highest type of creative ability.

It is in additive development that the vast knowledge and experience of Ethyl Research is so important. Our contacts with both the petroleum and automotive industries give us a unique insight into fuel needs. That's why you can continue to look to Ethyl Research for advancement in petroleum additives.

**ETHYL CORPORATION**
Research Laboratories

1600 West Eight Mile Road, Ferndale 20, Michigan
2600 Cajon Road, San Bernardino, California

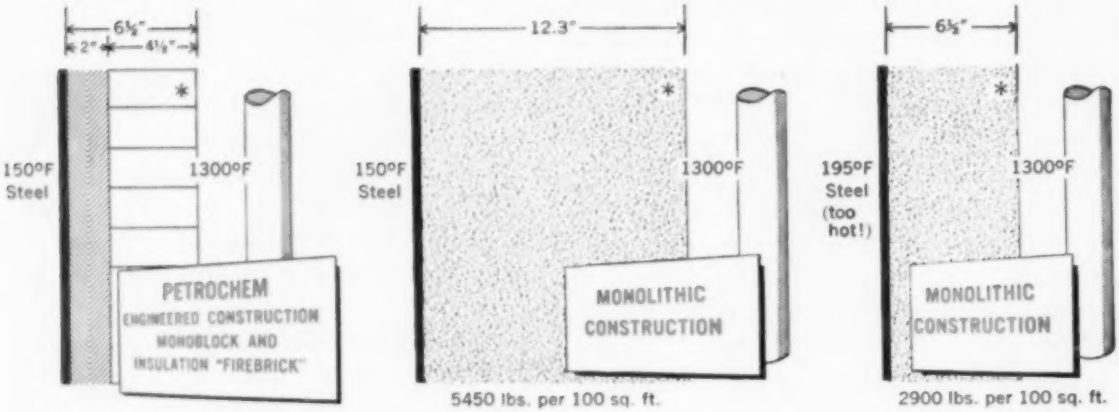
**Evaluation of every** additive calls for the combined talents of experienced research chemists and engineers.

**Additives synthesized** at Ethyl Laboratories represent thousands of hours of laboratory work.

# In furnaces as in processes compare the design to judge the advantages

As an example:

The wall construction of all Petrochem-Isoflow Furnaces is designed for 150°F maximum outside shell temperature.




*Based on B & W values.

The Petro-Chem design provides a thoroughly engineered wall construction. It is built with two tiers of monoblock supported on 18 inch centers and a circular arched wall of insulating firebrick. The inside of the steel shell is protected from the possibility of corrosion by a one-eighth inch thickness of Staylastic cement. This type of construction, independently supported monoblock and the circular arch of firebrick, bonded with Smoothset mortar, assures optimum efficiency and minimum maintenance.

The use of monoblock and insulating firebrick laid as a circular arch provides many advantages over a one-piece monolithic lining, including:

*1—Low weight, 2—Low heat conductivity, 3—High hot crushing strength, 4—Low expansion coefficient, 5—Resilient compressible backing, 6—Long life, 7—Nil maintenance.*

Also, this construction has low heat storage capacity, speeds both heating and cooling. Its light weight requires less concrete foundations and steel supports.

Compare and your judgment will affirm
Petrochem-Isoflow Furnaces are Most Efficient by any Comparison

**PETROCHEM-ISOFLOW FURNACES**

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

**PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.**

*Representatives:* Bethlehem Supply, Tulsa and Houston • Flagg, Brackett & Durgin, Boston • D. D. Foster, Pittsburgh • Faville-Levally, Chicago • Lester Oberholtz, Los Angeles • Gordon D. Hardin, Louisville • Turbex, Philadelphia

*International Licensees and Representatives:* SETEA—S.A. Comercial, Industrial, y de Estudios Tecnicos, Buenos Aires, Argentina • Promotora Nacional De Industrias, S.A., Caracas, Venezuela • Firma Dr. C. Otto & Comp. G.M.B.H., Bochum, Germany • Birwelco Ltd., Birmingham, England • Societe Anonyme Heurtey, Paris, France • Societe Anonyme Belge, Liege, Belgium • Heurtey Italiana S.P.A., Milan, Italy

Petroleum Processing

OCTOBER 1955

# Petrochemical Section

IN THIS SECTION

## Primaries Up Again

The 19% rise in output of primary petrochemicals, as against 38% the year before was market by a shift in B-T-X aromatics —p. 1592

## Six Answers

. . . to as many problems in petrochemical instrumentation with varying conditions of operating severity —p. 1594

*New nitroparaffin unit, Commercial Solvents, Sterlington, La.*

## Raw Materials Were Nearby

One factor in choosing a plant site—p. 1587

## In the Departments

Here's a simple, shop-built jig which will speed up making your U-bolts—(Plant Practices) p. 1599

New gate valve design will permit replacement of seats rings inside of 10 minutes using only a screwdriver, plus dozens of other new ideas in equipment and products—(What's New) p. 1629

OTHER DEPARTMENTS


| | |
|---|---|
| New Words | 1597 |
| Personals | 1604 |
| Patents | 1609 |
| Suppliers | 1613 |
| Meetings | 1619 |
| Books | 1623 |
| Information Offered | 1626 |
| Advertisers' Index | 1628 |
| Editorials | 1660 |

# ALUNDUM*

## High-Purity Fused Alumina

## *How can you use it to advantage?*

Among the many electrochemically refined materials produced by Norton Company, ALUNDUM fused alpha alumina is one of the most widely useful to industry. Thanks to its inherent properties of hardness, chemical stability and high density, engineers in various fields are finding many new applications for it.

Norton fused alumina is produced in a number of forms. Of these, 38 ALUNDUM* grain has proved particularly successful in applications demanding high purity. Electrically fused from Bayer-processed alumina, this white grain is shown by typical chemical analysis to be 99.49% pure $Al_2O_3$. It is insoluble in common solvents and extremely resistant to reduction. It is an amphoteric refractory and has high dielectric strength. Other characteristics include:

| | |
|---|---|
| **Melting point** | **about 3600° F.** |
| **Specific gravity** | **3.94** |
| **Crystal structure** | **hexagonal system (rhombohedral division)** |
| **Hardness** | **9.0 Mohs' scale** |
| **Index of refraction** | **1.76 mean** |

***Typical Product Applications*** in which Norton high-purity fused alumina is now working out to advantage are:

***For Catalytic Reactions.*** Norton fused alpha alumina carriers are outstanding for chemical stability and resistance to abrasion and erosion. Available in the form of spheres, rings and pellets they are used both in fixed bed oxidation reactions and as inert, low-density carriers for space filler applications where a low surface area (less than $1 m^2/gm$) is required. Other types of ALUNDUM catalyst carriers having surface areas in the range 5-60 $m^2/gm$ are also available.

***In Pebble Heaters.*** ALUNDUM heat exchange pebbles are giving excellent results in pebble heaters for heating gases above operating temperatures permissible in conventional tube furnaces. Their great resistance to abrasion, impact and repeated heating and cooling make them the ideal heat transfer medium in these devices. Also, their high refractoriness prevents them from the softening and "bridging" together that causes stoppages in the heater's moving bed.

***In Thermal Cracking Reactors.*** Particularly in Wulff Process Generators for cracking light hydrocarbons to produce acetylene gas and Koppers-Hasche Generators for cracking light hydrocarbons to produce a variety of gases and petrochemicals — checkers made of Norton ALUNDUM high-purity fused alumina provide definite advantages. Their excellent heat transfer properties, high refractoriness and resistance to erosion caused by hot gases are important. Their ability to withstand the thermal stresses of intermittent operation assures long life. And their purity prevents side reactions with the reacting gases, thus safeguarding product quality.

***In Gas Synthesis Generators.*** ALUNDUM fired shapes are ideal for lining generators of this type. Among the inherent characteristics of Norton high-purity fused alumina that work out very well are: high refractoriness, chemical stability, and inertness that prevents reacting with the contacting atmospheres.

Very many other uses for Norton high-purity fused alumina materials include: pure oxides and sintered refractories, refractory cements, wear-resistant parts, laboratory ware, coatings for rocket and jet plane parts and atomic energy equipment.

### *Other Norton Electrochemically Refined Materials*

include CRYSTOLON* silicon carbide, MAGNORITE* magnesium oxide, NORBIDE* boron carbide, FUSED ZIRCONIA and many others, including a number still under development. These high-melting materials, which have varied applications in many fields, are also the basic ingredients of the famous Norton Refractory Rx's — refractories *engineered and prescribed* for the widest range of uses.

### *For Your Own Applications Or Developments*

Norton Company not only supplies these materials in crude form, but has extensive facilities for processing and fabricating — and is ready to work with you in engineering materials to your particular requirements. A new booklet "Norton Refractory Grain — Electrochemically Refined" contains detailed information. For your copy, write to NORTON COMPANY, Refractories Division, 269 New Bond Street, Worcester 6, Massachusetts.

NORTON

REFRACTORIES

*Engineered... Rx... Prescribed*

*Making better products... to make your products better*

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries



*(To obtain more data on advertised products see page 1628)*

**FROM AN INTENSIVE STUDY** of this region, the Arkansas, White, and Red River basins areas, have come . . .

*Basic Guides for*

# Locating a Petrochemical Plant

ONCE a decision on the manufacture of selected chemicals from petroleum fractions or natural gas has been made, and the specific processes and technological problems have been resolved, a decision must be made on the plant site.

**Four economic factors loom large in this decision:**

1—What will be the future availability of feed stocks suitable for the area where the plant is proposed?

2—What will be the relative transportation costs of the feed stock and fuel gas in various locations?

3—What will be the relative transportation costs of finished products to the markets the company wants to reach?

4—What scale of production will be most advantageous for the plant being considered?

**These four basic principles were worked out** by a group of oil company and refinery construction engineers — among other authorities — in the the course of preparing for the U.S. Department of Commerce a special report on the location factors for the petrochemical industry in the Arkansas, White, and Red River basins region.

Although the report concerns itself with a specific region of the country, the principles developed are broad enough to be useful in selecting plant sites in any part of the country. They apply whether the site under consideration is in an oil and gas producing territory, in a market area, or in a market gateway where shipment of both raw materials and finished products would be involved.

**The report is part of a special five-year program** carried on by the Department of Commerce and

**1—Choosing the Feedstock** . . . . . **p 1589**

**2—Feedstock Transport Costs** . . . . . **p 1589**

**3—Product Shipping Costs** . . . . . **p 1590**

**4—And How About Plant Size?** . . . . **p 1591**

other agencies to survey the land and water resources of the AWR region. It was written by Professor Walter Isard and Eugene W. Schooler, both of the Department of City and Regional Planning, Massachusetts Institute of Technology.

**Other costs common to refining and chemical** manufacturing were recognized as varying with the geographical areas. In general the prevailing differences in these costs were not considered great enough to have a primary bearing on a petrochemical plant location.

An exception was noted in instances where large volumes of processing chemicals, such as chlorine, for example, were required in the proposed operation. Transportation costs for such materials would affect plant operating costs.

**Summarizing on these secondary costs** as related to petrochemical plant location, in the AWR region particularly, the report states:

**"Plant costs,** interest and related charges, maintenance costs, cooling water costs, and most process chemical costs are not expected to show much variation among regions. The costs of chlorine or its derivatives, however, are expected to vary significantly from region to region, and hence will affect the location pattern of new facilities for the production of chlorinated petrochemicals which consume large volumes of chlorine.

**"Labor costs and power costs,** too, are not expected to exhibit major variations among regions, primarily because only relatively small amounts of labor and power are required for petrochemical production. Hence, for non-chlorinated petrochemicals, there are no major locational pulls or pushes associated with any of the costs already mentioned.

"Differences among regions in fuel, steam, and feedstock costs reduce to difference in transport costs of the equivalent volume of natural gas. These transport costs are subject to major variation among regions. A natural gas site like Monroe, La., avoids them, while a northeast location, like New York City, must incur them. Likewise, transport costs on finished products exhibit major variation among regions. A natural gas site must incur them in shipping to major markets; market and gateway points in the Northeast can largely avoid them.

**"Another major set of cost differentials** among regions may arise from differences in achievable size of plant or productive unit. Regions which are able to market large outputs can reap economies of scale and can have major advantages over regions which can market only a small output.

"No blanket statement regarding petrochemical plant location is justified which will cover the entire list of products considered. Some products, such as acrylonitrile and ethanolamines, are primarily raw material oriented. Others, such as ammonia and ethyl chloride, are primarily market oriented when a large enough scale of production can be achieved."

**The following conclusions** on the general future geographic pattern of petrochemical expansion in the U.S. are given in the report on location factors in the Arkansas-White-Red River basins:

"1—Production will tend to be associated with large-scale plants (petroleum or chemical manufacturing).

"2—Large tonnage petrochemicals will tend to be shipped by water from production sites in major distribution plants, when the production sites and the distribution points do not coincide.

"3—The major portion of expansion in natural gas-based petrochemicals will take place in natural gas areas.

"4—Some expansion in natural gas-based petrochemicals, especially in complexes of related petrochemicals, will occur at or near major metropolitan market areas and gateway points. This is partly the result of the development of long-disatnce pipeline transmission of natural gas. Also, because of its power cost advantage in chlorinated chemicals production, the Ohio Valley particularly qualifies as a desirable market-gateway point qualification.

"5—The future pattern of natural gas-based petrochemical expansions is therefore likely to be somewhat less concentrated in the natural gas producing areas than is current capacity.

"6—Expansions in petrochemicals based on propylene, butylene, and aromatic and naphthenic feedstocks are likely to continue to be linked to refinery locations.

"7—Major expansions in the production of these petrochemicals are likely to occur in the Gulf Coast area, where current oil refinery capacity is concentrated and where major expansion in refinery facilities is to be expected in the future. However, whether or not the geographic pattern of expansion of these petrochemicals will be less concentrated than is current capacity will depend heavily upon the future geographic pattern of refinery expansion."

## Petroleum Processors Aided in this Survey

Helpful data for oil and chemical manufacturing companies on the "locational forces" that will shape the coming expansion of the petrochemical industry is presented in the U.S. Department of Commerce report "Location Factors in the Petrochemical Industry," on which this article is based.

This study is part of a general survey of the natural resources of the Arkansas - White - Red River basins of the southwest, directed by the Commerce Department in cooperation with the Arkansas-White-Red River Basin Committee, a joint federal-state group.

The government agencies had the cooperation of various petroleum, natural gas and engineering authorities in the AWR study on rating future petrochemical plant locations. The oil companies included Gulf Research and Development Co., Phillips Petroleum Co., Standard Oil Co. of Indiana, Cosden Petroleum Co.

Among individuals credited with giving assistance are:

A. W. Pratt, R. L. Geddes and H. C. Schutt, Stone and Webster Engineering Corp.

W. W. Kraft, M. P. J. Bogart and A. S. Brunjes, Lummus Co.

B. Fogler and R. F. Messing, Arthur D. Little Co.

W. C. Rousseau and G. A. Randall, Badger Manufacturing Co.

Charles King and N. Adams, N. W. Kellogg Co.

R. E. Howard, Transcontinental Gas Pipe Line Corp.; H. L. Stowers, Texas Gas Transmission Corp.; J. J. King, Tennessee Gas Transmission Co.

The full report, a 96-page booklet entitled "Location Factors in the Petrochemical Industry, with Special Reference to Future Expansion in the Arkansas-White-Red River Basins," may be secured from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. The price is $3.00.

*Plant Location Factors*

# 1—Selecting the Feedstock

POSSIBLE raw material feedstocks for new petrochemical ventures include natural gas (mainly ethane), refinery gases, crude oil, distillate stocks, light hydrocarbon streams from natural gasoline plants, liquefied petroleum gases, and catalytic reformate.

In selecting from these supplies two important general factors must be considered.

1—The yield and value of the chemical products that can be derived from the raw material.

2—The economic attractiveness of uses for the raw material other than as a chemical feedstock.

"In general, of several raw materials in equal abundance, those whose chemical derivatives are of high weight yield and high unit value, and whose alternative uses are of a low order of economic attractiveness, will tend to furnish the largest source of supply for future increases in petrochemical production. Obviously, when the total available amounts of the various raw materials are of different magnitudes, this, too, will affect the absolute amounts of each to be used for chemical conversion.

Each of the above mentioned feedstocks has been studied with respect to its possible future use as a chemical feedstock, with particular attention given to the influence of its alternative uses.

**Natural Gas:** As long as the trend continues to pipe natural gas for fuel to the large markets of the North and East, the supply of cheap gas for chemical conversion will become more limited. Even though new reserves are constantly discovered, the possibility of reaching these large fuel markets will enable the gas producers to command higher prices.

Since the Northeast has large supplies of coal, further progress in coal gasification may make available in the future large quantities of this type of gas which will compete with natural gas in the large fuel markets. This may tend to stabilize the price of gas, but at a higher level than at present.

Natural gas (methane) will continue to be used directly for the production of large volumes of such chemicals as ammonia and methanol.

**Light hydrocarbon streams:** Since the activities of natural gasoline plants will increase with the long distance piping of natural gas, the supply of these light hydrocarbon streams will increase. So far as chemical production is concerned, the ethane streams will probably be more favorable than the propane streams. The only alternative disposal for ethane would be to pump it back into the natural gas pipeline, whereas the propane stream can be used to produce high quality liquid propane.

Future demand for ethylene may become so great that ethane-from-natural gas, favored for ethylene manufacture, will advance from its present principal status as a natural gasoline by-product to that of a joint product with natural gas and/or LPG. In such a situation the costs of capturing ethane would increase as greater percentages were stripped, and the heavier propane is necessarily obtained with the lighter ethane. This might make available larger volumes of propane for ethylene production. However, ethane will be preferred.

**Crude Oil:** While the use of crude oil as a raw material feedstock for chemical production results in large volumes of by-product stocks that can then be processed into conventional petroleum products, the amount of high-value premium grade petroleum products that must be foregone is significant.

This means that crude oil is considered a costly chemical raw material. Relatively expensive processing and shipping costs are also involved.

**Light Distillate Stocks and LPG:** Since the lighter crude oil fractions are preferred feedstocks for gasoline production, their availability as petrochemical raw material is greatly limited until more valuable chemicals can be made from them.

LPG, especially propane, is to some extent now used for chemical production in areas which do not have oil refinery capacity or other sources of gaseous hydrocarbons. Propane is a relatively expensive raw material because of its growing demand as a fuel and because of relatively high cost. Although the potential future supply of propane and other LPG is very large, it does not now promise to be more than a relatively minor portion of future petrochemical feedstocks.

**Catalytic Reformate:** As is the case with crude oil and distillate stocks, this use of the petroleum stock competes with its use in the production of high grade motor fuels. Hence the aromatics from reformate become relatively expensive chemical raw materials. Nevertheless, the opinion is widely held that the demand for aromatics will expand sufficiently to justify the production of very considerable amounts of petrochemical aromatics.

**Refinery Gas:** Various refining developments have changed the status of refinery off-gas from a surplus by-product with little value to a more profitable raw material with several alternate uses. However, it is likely that refinery gases will constitute a more desirable material for expansion in the production of some petrochemical intermediates than in others.

For example, the supplies of propylene in refinery gases are still adequate and propylene from refinery gas is less expensive to produce than propylene from cracking propane. The former involves only one step, separation, while the latter involves two steps, cracking and separation. Thus the opinion is held that, in spite of the alternate uses for refinery gas, it will continue to be the major source of propylene supplies. The same general considerations apply in the case of butylene.

It is more valid to assume that refinery gases will constitute a more favorable future source of supply of propylene and butylene than of ethylene.

*Plant Location Factors*

# 2—Feedstock Transport Costs

THE importance of the transport cost of feedstock and fuel gas in locating a petrochemical plant, and even the selection of the raw materials itself, depends on the type of location under consideration. These types include:

1—Construction of a plant at a raw materials source and shipment of the product to the market (where the market does not coincide with the raw material source), or to several markets.

2—Construction of a plant at a market (or at a focal point within a broad market area) and shipment of raw material to the plant (with local shipment of product to points within the broad market area).

3—Construction of a plant at a non-raw material, non-market site and the shipment of both raw materials and product.

**When considering refinery gases as raw material,** it should be assumed that long distance pipelines for this purpose will never be established.

The large volumes of gas which would have to be shipped to justify the construction and operation of a major line will not be forthcoming.

However, the only practicable method for transporting such gases is by pipeline, since they are not easily liquefiable. Therefore, the location of a petrochemical operation using refinery gas is tied to the location of the refinery and the transportation cost of the raw material should not be a material factor.

However, certain fractions of refinery gas such as propylene and butylene (but not ethylene) can be separated and easily liquefied. In this form they can be shipped relatively easily. Their transport cost is then a factor varying directly with the distance from the source of their supply. Petrochemical production based on these intermediates is not necessarily tied to the refinery location.

**The location of petroleum aromatics** production will be determined by considerations relevant to the location of the major products of the refinery. However, it is feasible to transport these aromatics and the location of plants producing aromatic derivatives is not directed by the location of the refinery.

**In the case of petrochemicals from crude oil,** distillate stocks and LPG, there exists the possibility of location either at the raw material source, at the market, or elsewhere, since these raw materials can be transported by rail, ship or pipeline. Other factors than raw material transport cost would be more important in determining petrochemical plant location.

**As to light hydrocarbons from natural gas** as raw material for petrochemical manufacture, it is possible that in the future more of the propane and butane will be stripped from the gas at or near the market, in order to avoid high freight costs in LPG. In such a case, ethane would be available both in the natural gas fields as a by-product of natural gasoline stripping, and at various other locations as a joint product along with butane and propane. Thus the production of petrochemicals from ethane could be located either at or near the gas fields or elsewhere along the pipelines.

Examples of the treatment of lean gas at or near the market end of the pipeline, to extract more ethane along with additional amounts of heavier hydrocarbons are the Tennessee Gas Transmission Co.'s hydrocarbon extraction plant in Kentucky and the Panhandle Eastern Pipeline Co.'s similar plant in Illinois. Informed sources state, with reference to the Kentucky plant, that neither the natural gasoline-LPG operation nor the ethane recovery and subsequent chemical manufacturing operation would be economically feasible alone.

**Thus, even under present conditions,** it is possible and economically feasible to have sources of natural gas ethane supply in regions other than the Southwest. In such cases the transport cost of the petrochemical feedstock would vary over a considerable range.

While it is technologically possible to produce butylene and propylene from natural gas butane and propane, there is at present no indication that such processes will become economically competitive in the future. In the consideration of petrochemical ventures using butylene and propylene as feedstocks, the location would have to be where these materials are available in volume in refinery gases.

**An estimate of natural gas transmission costs** for a future petrochemical plant requires consideration of possible changes in the technology of gas transmission. Some authorities believe that the period of rapid development here has already taken place. While many refinements and improvements in gas transmission remain to be realized, the likelihood of further fundamental changes or major innovations in the foreseeable future will be small.

On this assumption, the investigators of the possibility for petrochemical expansion in the AWR region set up minimum and maximum gas transmission costs that might be safely used in figuring transport costs for natural gas raw material for various locations. Judging that a 34-in. pipeline system can be expected in the future, the lowest transmission cost to be considered is based on such a system operating under conditions of the most favorable load factor; i.e. 90% to 95%.

Available data indicated that a minimum of 1.3 cents per 1000 cu. ft. per 100 miles is to be expected from a 34-in. gas line operating at a 90-95% load factor. This estimated cost provides a lower limit for a range of natural gas transmission costs that might be used in figuring feedstock and fuel gas transport costs in different locations.

**Considering the forces of competition** prevalent among natural gas transmission companies, it was judged that the future maximum cost to pipe 1000 cu. ft. of gas 100 miles would be associated with the operation of a 26-30 in. pipeline system operating at a 60-65% load factor. Available data suggested 1.7 cents as likely to characterize the maximum cost.

Knowing the approximate volume of gas required for the desired petrochemical output, it was felt that the minimum and maximum transmission costs set up could be used to give low and high transport cost differentials on natural gas feedstocks, fuel gas and steam on various locations.

*Plant Location Factors*

## 3—Product Transport Costs

TO JUDGE effectively the significance of the transport factor in locating petrochemical plants, it is also necessary to consider the transportation costs of the finished products to any markets.

Appraisal of this factor in plant location should include the possibility that the future movement to markets of some large volume products may be by barge or coastwise shipping. In such event, coastal or interior waterway sites for plants making these products would be favored over inland sites, in respect to transport costs on finished products.

Referring to the study of the Arkansas-White-Red river basins, the report states that for large tonnage petrochemicals, Houston has a clearcut site advantage over Amarillo, Texas, or Monroe, La., in reaching the Eastern seaboard.

"When we consider large tonnage ship movement of ethylene glycol from the Gulf Coast area, the Houston location has a transport cost advantage over a New York location," the report states. "Ship rates are so low that it becomes feasible to locate at a Gulf Coast natural gas site and ship the finished product to the market, as compared with minimum transport cost of the natural gas raw material."

"However, when we consider shipment by rail only, it becomes definitely

advantageous, from a transport cost standpoint alone, to locate at the market site, viz., New York City."

For the consideration of barge and ship movement of finished products it was necessary to set up some representative tariffs which might characterize the shipment of liquid chemicals. It was recognized that different rates would apply to those liquid chemicals requiring pressure tanks than where ordinary tanks were used. Furthermore, of those products requiring ordinary tanks, a distinction between corrosive and non-corrosive chemicals must be maintained. In the absence of published standard rates, the following rates were set up from available data as representative of what might be expected in efficient barge operation for long distance water transportation.

3 mills/ton-mile for non-corrosive petrochemicals using non-pressure tanks.

3.5 mills/ton-mile for liquid chemicals which are corrosive but do not require pressure tanks.

8 mills/ton-mile for chemicals requiring pressure tanks.

In the absence of published rates, it was also necessary to calculate tanker rates to apply for shipment of large tonnage petrochemicals between the Gulf Coast and Eastern seaboard.

It was assumed that an ordinary liquid chemical tanker of 5000 tons capacity, under efficient conditions, could be operated profitably at a rate of 4.5 mills/ton-mile on long intercoastal shipments of non-pressure, non-corrosive chemicals. For tankers of 10,000-12,000 tons capacity the ton-mile rate might fall to 3.5 mills. When the products are corrosive or for any other reason require specially lined tanks, it was felt that the above costs might be raised by 0.5 mills in each case.

On the basis of information available on pressure tankers, it was estimated that the ton-mile cost for pressure tanker shipments of ordinary chemicals will be 2 mills greater than for non-pressure tanker shipment. This would be 6.5 mills in the case of a 5000-ton tanker, and 5.5 mills in the case of a 10,000-12,000-ton tanker.

For calculating rail shipping costs of petrochemicals, the regular freight classifications can be used, with their exception and commodity rates.

Finally, in calculating transportation rates, other charges must be included, such as terminal and handling and rental charges on transportation equipment, for both raw materials and finished products. While these may not be comparable in magnitude to other costs of a petrochemical operation, they must be considered with other factors when the relative advantages of various locations for a future plant are being appraised.

*Plant Location Factors*

## 4—The Size of the Plant

CERTAIN obvious factors dictate plant size for the location under consideration, such as volume of feedstock available and the volume of the market to be served. Regions which are able to market large outputs can reap economies of sale and can have major advantages over regions which can market only small output.

However, since there is in most instances an optimum capacity for the most efficient plant operation, it is also necessary to determine for the petrochemical project under consideration the optimum scale of operation to be achieved and to consider this as a major location factor.

If it were dictated by physical or technological reasons that plants of only one given size had to be constructed, regardless of their geographical location, then it would not be necessary to consider these economies.

However, in the petrochemical industry, plants of different size will continue to be associated with different market and raw materials locations. This entails substantial differences in the costs of production among sites.

Past experience has established the fact that both capital costs and labor costs associated with different capacities are not directly proportional to these capacities. As we proceed from one plant site to another of increasing size, both capital costs and labor costs tend to rise, within a significant range less than proportionately.

There are various reasons for this relationship. Doubling the capacity of a distillation tower or of a pot does not entail doubling the quantity (and hence the cost) of steel required. To take another example, five men may be required to handle three units of equipment, whereas only eight men may be needed to tend six units, thus providing greater efficiency.

It is beyond the scope of this study to discuss the various counts on which economies of scale arise. We are concerned only with how the existence of these economies affect the future location pattern of the petrochemical plant industry.

Several aspects of this problem are discussed. Economies of scale do not continue indefinitely with increase of capacity. The consensus of chemical engineers is that once a certain capacity is reached, economies of scale are no longer obtainable with further increases. It is recognized that so-called optimum capacities vary greatly from product to product and they also vary with the state of technological advancement of the processes involved. However, when the point is reached that economies of scale do not accompany increase in capacity, then the duplication of an existing unit should be considered, or an additional plant should be constructed possibly at a new location.

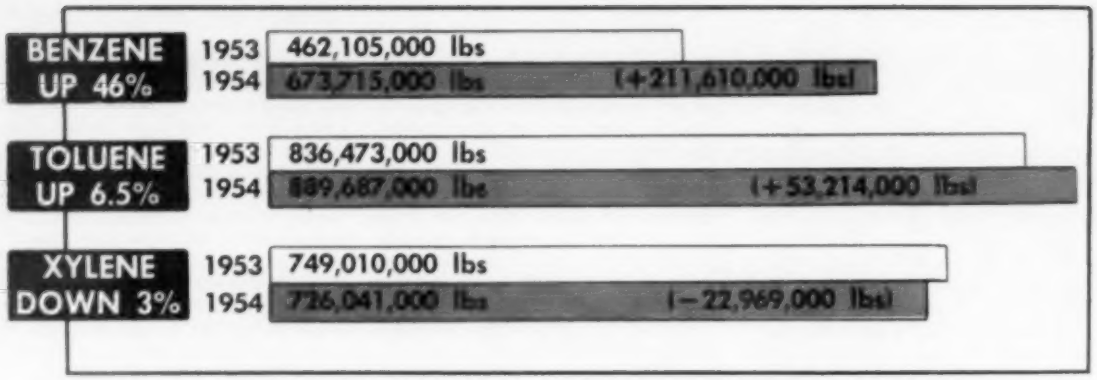
On the other extreme, because of the steep rise in unit production costs that would arise, it is not feasible to operate a plant smaller than a certain minimum size. It is not to be denied that plants smaller than this "minimum feasible" capacity can be operated. However, it is generally agreed among engineers that such operation would not be profitable.

Thus for the petrochemical venture under consideration, the optimum minimum producing capacity for each product should be determined, as a factor in plant location. This minimum capacity will vary from product to product, with the state of technology and with the age and maturity of the particular processes involved.

In attacking the problem of economies of scale, the rate at which various operating costs rise with increase in scale of operations must be established. There is general agreement that such inputs as feedstock, utilities, water, catalyst and chemicals tend to increase linearly with scale.

The two inputs or costs which do not rise linearly are the services of capital and equipment, and labor. Therefore, it is necessary to establish factors which relate increases in each of these items to increases in capacity.

If these factors can be determined, since a factor of unity can be used for other plant cost items, data can be arrived at from which it will be possible to estimate the economies of scale in the manufacture of all products under consideration.




**A PATTERN OF SHIFTS** in B-T-X aromatics last year slowed the output growth of the nation's petrochemicals

# Primary Petrochemicals—Up 19%

STILL climbing at a high rate of growth — 19% higher in 1954 than in 1953—the primary petrochemicals have slowed down in their rate of climb. The change in the preceding year was 38% (1952 to 1953).

The changing pattern was keynoted to some extent by the shift in the benzene, toluene, and xylene aromatics as indicated in the chart above. These products account for a fairly sizable portion of all primary petrochemicals —about 17.5%. Although not exactly a pacemaker, they are considered a good barometer of trends.

Highlights of the current statistics are shown in the summary table below, with detailed figures being given in the large table on the opposite page. These are from a preliminary report from the United States Tariff Commission on 1954 operations in synthetic organic chemicals.

The Commission does not report petrochemicals as such. However, it does do this. As part of its annual report on synthetic organic chemicals, it compiles data on "U. S. Production and Sales of Crude Products from Petroleum and Natural Gas for Chemical Conversion." This category includes two main groups: (1) aromatics and naphthenes, and (2) aliphatic hydrocarbons.

These two are considered as comprising the primary petrochemicals—petroleum hydrocarbons which generally serve as raw materials for further processing into finished products.

The rate of growth in production has shifted from the aromatics to the aliphatics. Between 1954 and 1953, aromatics increased 15% while the aliphatics went up 21%. The preceding 12-month period saw the aromatics percent change at 56% while that for the aliphatics was 33%.

Sales have dropped off, however, to closer to 1952 levels. Calculated as a percentage of production: in 1954 they were 58% for total primary petrochemicals. In 1953 they had been up to 64%, and the year before that down at 60%. (1952 figures not shown.)

A perceptible downward shift occurred in the value of sales of aliphatics, and the positive increase by the aromatics was still not sufficient to prevent a downtrend in total sales value of all primary petrochemicals.

### *Highlights of Primary Petrochemical Statistics—1954 vs. 1953*

| | Aromatics and Naphthenes | Aliphatic Hydrocarbons | TOTAL |
|---|---|---|---|
| **PRODUCTION, lbs/yr.** | | | |
| 1954 | 2,874,008,000 | 10,067,375,000 | 12,941,383,000 |
| 1953 | 2,499,014,000 | 8,320,230,000 | 10,819,244,000 |
| Change | +374,994,000 | +1,747,145,000 | +2,122,139,000 |
| % Change | +15% | +21% | +19% |
| **SALES, lbs/yr.** | | | |
| 1954 | 2,026,436,000 | 5,447,939,000 | 7,474,375,000 |
| 1953 | 1,793,722,000 | 5,191,932,000 | 6,985,654,000 |
| Change | +232,714,000 | +256,007,000 | +488,721,000 |
| % Change | +13% | +5% | +7% |
| **SALES, as a percentage of production** | | | |
| 1954 | 71% | 54% | 58% |
| 1953 | 72% | 62% | 64% |
| **VALUE OF SALES, $/yr.** | | | |
| 1954 | 72,291,000 | 203,665,000 | 282,956,000 |
| 1953 | 72,979,000 | 226,000,000 | 298,979,000 |
| Change | +6,312,000 | −22,335,000 | −16,013,000 |
| % Change | +8.5% | −10% | −5.5% |
| **UNIT VALUE, $/lb.** | | | |
| 1954 | $0.04 | $0.04 | $0.04 |
| 1953* | 0.041 | 0.044 | 0.043 |

* 1953 unit values were reported to three decimal places; 1954 to two

## Crude Products from Petroleum and Natural Gas for Chemical Conversion, 1954 and 1953

Source: U. S. Tariff Commission (1954 figures preliminary)

| | 1954 | | | | 1953 | | | |
|---|---|---|---|---|---|---|---|---|
| AROMATICS and NAPHTHENES[1] | Production 1,000 lbs. | Sales, Quantity 1,000 lbs. | Sales, Value, $1,000 | Unit Value, $/lb.[2] | Production 1,000 lbs. | Sales, Quantity 1,000 lbs. | Sales, Value, $1,000 | Unit Value, $/lb.[2] |
| Alkyl aromatics, distillates, solvents | 520,286 | 513,086 | 10,559 | 0.02 | 403,168 | 398,043 | 9,095 | .023 |
| Benzene (except motor grade), total | 673,715 | 379,049 | 24,631 | 0.06 | 462,105 | 301,051 | 20,790 | .069 |
| Benzene, 1° | 232,867 | 206,098 | 13,277 | 0.06 | 75,975 | — | — | — |
| Benzene, 2°[3] | 440,848 | 172,951 | 11,354 | 0.07 | 386,130 | — | — | — |
| Cresylic acid, crude | 21,576 | 9,677 | 348 | 0.04 | 10,780 | 6,246 | 320 | .051 |
| Naphthenic acids, total | 23,666 | 17,438 | 1,688 | 0.10 | 23,123 | 14,294 | 1,541 | .108 |
| Acid No..220-224[4] | 1,194 | 901 | 82 | 0.09 | — | — | — | — |
| Acid No. 225-249 | 12,578 | 13,644 | 1,424 | 0.10 | 10,999 | 10,557 | 1,222 | .116 |
| All other | 9,894 | 2,893 | 182 | 0.06 | 12,124 | 3,737 | 319 | .085 |
| Toluene, all grades, total | 889,687 | 677,461 | 26,750 | 0.04 | 836,473 | 658,195 | 26,862 | .041 |
| Nitration grade, 1° | 366,822 | 292,612 | 11,940 | 0.04 | 192,113 | 166,440 | 7,441 | .045 |
| Pure commercial grade, 2° | 405,845 | 309,821 | 12,350 | 0.04 | 282,338 | — | — | — |
| All other | 117,020 | 75,028 | 2,460 | 0.03 | 362,022 | — | — | — |
| Xylenes, mixed | 726,041 | 409,901 | 14,896 | 0.04 | 749,010 | 402,213 | 13,637 | .034 |
| All other[5] | 19,037 | 19,104 | 419 | 0.02 | 14,355 | 13,680 | 734 | .054 |
| **TOTAL, aromatics and naphthenes** | **2,874,008** | **2,026,436** | **79,291** | **0.04** | **2,499,014** | **1,793,722** | **72,979** | **.041** |
| **ALIPHATIC HYDROCARBONS** | | | | | | | | |
| $C_1$ Hydrocarbons, Methane[6] | 44,036 | 43,125 | 579 | 0.01 | — | — | — | — |
| $C_2$ Hydrocarbons, total | 2,700,464 | 440,983 | 15,875 | 0.04 | 2,280,363 | 362,350 | 12,761 | .035 |
| Ethane | 355,820 | 121,186 | 762 | 0.01 | 144,623 | 108,450 | 720 | .007 |
| Ethylene[7] | 2,344,644 | 319,797 | 15,113 | 0.05 | 2,135,740 | 253,900 | 12,041 | .048 |
| $C_3$ Hydrocarbons, total | 2,878,625 | 2,264,874 | 25,350 | 0.01 | 2,439,041 | 1,715,575 | 18,652 | .011 |
| Propane | 1,675,124 | 1,651,235 | 16,659 | 0.01 | 1,216,984 | 1,043,742 | 10,952 | .010 |
| Propane, propane-propylene mixtures | 1,203,501 | 613,639 | 8,691 | 0.01 | 1,222,057 | 671,833 | 7,700 | .011 |
| $C_4$ Hydrocarbons, total[7] | 3,563,029 | 2,186,851 | 144,800 | 0.07 | 3,079,571 | 2,780,070 | 182,374 | .066 |
| 1,3 Butadiene, grade for rubber, total[8] | 808,731 | 789,174 | 110,292 | 0.14 | 1,152,197 | 1,135,292 | 136,235 | .120 |
| Produced for Government account | 690,744 | — | — | — | 1,051,468 | — | — | — |
| Produced for private account | 117,987 | — | — | — | 100,729 | — | — | — |
| n-Butane | 459,196 | 237,024 | 2,144 | 0.01 | 388,581 | 236,965 | 2,985 | .013 |
| 1-Butene and 2-Butene mixtures[9] | 1,214,756 | 830,023 | 25,177 | 0.03 | 906,732 | 882,803 | 26,714 | .030 |
| Isobutane | 227,706 | 186,243 | 2,598 | 0.01 | 97,625 | 92,926 | 1,413 | .015 |
| All other[10] | 852,640 | 144,387 | 4,589 | 0.03 | 534,439 | 432,084 | 15,027 | .035 |
| $C_5$ Hydrocarbons[11] | 179,395 | 161,678 | 2,897 | 0.02 | 38,260 | 25,722 | 1,713 | .066 |
| All other aliphatic hydrocarbons and derivatives, total | 701,826 | 350,428 | 14,164 | 0.04 | 482,992 | 308,215 | 10,500 | .034 |
| Di-isobutylene | 21,997 | — | — | — | 23,157 | — | — | — |
| Dodecene (tetrapropylene) | 316,337 | 174,546 | 6,636 | 0.04 | 176,926 | 125,100 | 4,685 | .037 |
| Nonene (tripropylene) | 98,557 | 12,197 | 444 | 0.04 | 60,986 | 4,828 | 217 | .045 |
| Hydrocarbon derivatives, total[12] | 5,331 | 4,991 | 1,035 | 0.21 | 2,681 | 2,496 | 462 | .185 |
| Ethyl mercaptan | 1,930 | — | — | — | — | — | — | — |
| All other | 3,401 | 4,991 | 1,035 | 0.21 | — | — | — | — |
| All other[13] | 259,604 | 158,694 | 6,049 | 0.04 | 219,242 | 175,791 | 5,136 | .029 |
| **TOTAL, aliphatic hydrocarbons** | **10,067,375** | **5,447,939** | **203,665** | **0.04** | **8,320,230** | **5,191,932** | **226,000** | **.544** |
| **GRAND TOTAL** | **12,941,383** | **7,474,375** | **282,956** | **0.04** | **10,819,244** | **6,985,654** | **298,979** | **.043** |

(1) The chemical raw materials designated as aromatics are in some cases identical with those obtained from the distillation of coal tar. However, the statistics given in the above table relate only to such materials as are derived from petroleum and natural gas.

(2) 1953 unit costs were reported to three decimal places, 1954, to two.

(3) Includes a small amount of 90% benzene.

(4) This data reported separately for first time for 1954; included in "All other" in 1953.

(5) Figures for 1954 include data for motor grade benzene, cyclopentane, petroleum phenols, sodium carbolate and phenate, and hydrocarbon polymers; figures for 1953 include these plus dicyclopentadiene.

(6) Includes a small amount of ethylene from coke-oven gas.

(7) Does not include data on butane and butene blending stocks for motor fuels.

(8) Sales value for 1954 partly estimated.

(9) The statistics represent the butene content of crude refinery gases from which butadiene is manufactured.

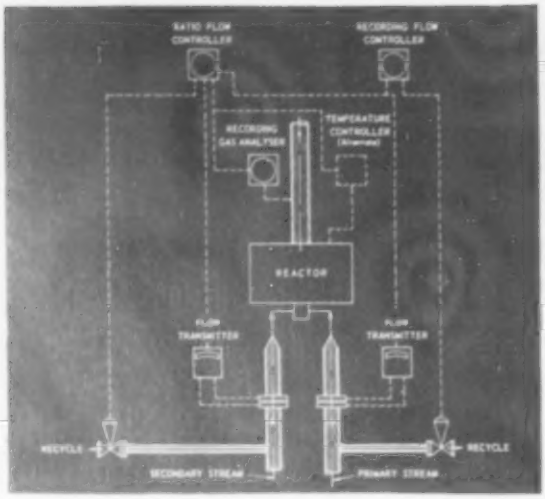
(10) Figures include data for isobutylene, 1-butene, 2-butene, butane-butylene, and butadiene-butene mixtures and concentrates.

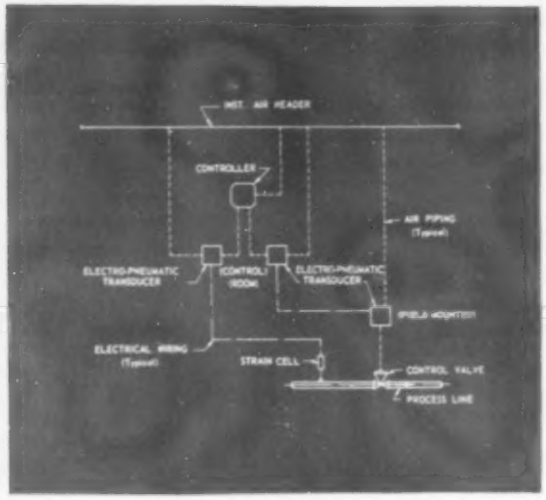
(11) Includes data for pentanes, pentenes, isoprene and mixtures.

(12) Figures for 1954 include data for de-tert-butyldisulfide, miscellaneous mercaptans, and mixed alkane sulfonic and aliphatic acids; in 1953 there was no separate figure reported for ethyl mercaptan.

(13) Figures for 1954 include data for acetylene, hexanes, heptenes, octanes and octenes, polybutene, eicosane, and hydrocarbon mixtures; figures for 1953 include these plus methane.

# Six Petrochemical Instrumentation




## 1—Ratio Flow Control of Gas Streams

There are some petrochemical processes which use a gas-phase reaction. To attain efficient and successful operation, close control of raw material flow is necessary. The exact quantities of gases must be fed in order to keep the system in chemical balance.

Failure to meet this requirement could result in loss of product yield and waste of power and other services in handling the process constituents.

A solution to the control of such gas-phase reactions can be by the use of standard flow instruments properly integrated to give the required material quantities. A flow transmitter sending an output signal to a ratio flow controller establishes a fixed point for the primary stream which balances against the secondary stream flow.

A monitor control—such as temperature point or gas analysis—provides a means for maintaining the proper portions of feed components for maximum reaction efficiency.

The output from the monitor positions the balance point between the flow transmitter outputs and results in a flow change of the secondary streams to keep the process in proper balance.

The schematic arrangement is illustrated in the sketch above.

A variation in this system would be to have the monitor control recorded on a standard recording instrument with the secondary flow control instrument being set manually by the operating personnel.

Safety features can be incorporated into such a control system to shut down the process in case of interruption of either the primary or secondary flow system because of an emergency situation.

This automatic control scheme for gas-phase reactions has been used very successfully in petrochemical plants. The incorporation of safety shutdown features has proved to be a very valuable part of the installation for protection of personnel and equipment.

## 2—Pressure Control by Strain Cell

The problem of controlling pressures in piping systems above those encountered in normal operation, and with fast speed of response, was solved by the use of a strain cell.

The process involved was such that normal time lags in transmission from the primary element and the final control loop could not be tolerated. It was also desirable that the primary element detect minute pressure changes.

The controller was required to position a pneumatically operated control valve, set another controller, and supply alarm and interlock device contacts (see drawing above for details of the installation).

To fulfill this requirement, a resistance-strain pressure cell was chosen as the primary device. The receiving instrument was one of the electronic type, calibrated with a suppressed reading; that is, full scale is used for recording only a portion of the resistance change of the strain cell. By use of this method of instrumentation, maximum sensitivity is obtained.

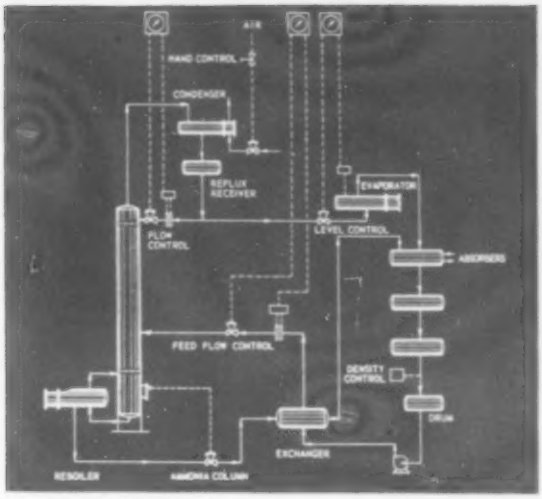
The receiving output of the instrument is a pneumatic signal, which is converted into an electrical signal. This in turn is converted to a pneumatic signal near the pneumatically operated control valve.

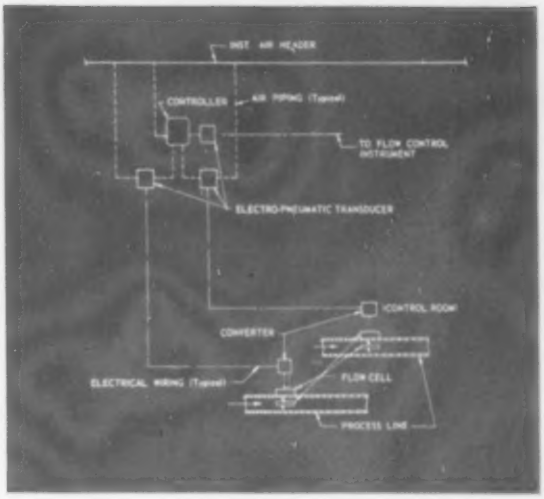
By using this system, long pneumatic control lines are replaced with a pair of electrical conductors, and it is necessary only to supply electrical power at the pneumatic-to-electric signal changer.

The method of converting from a pneumatic signal to an electrical value for transmission, and then back to pneumatic, was handled by the use of an electronic pressure transmitter connected with a servo electrical-pneumatic transducer.

Additional costs for such a scheme of instrumentation would seem rather high for ordinary types of control. However, as was pointed out, the speed of response required for this control plus the lower costs of the installation justified the scheme.

# Problems and Their Solutions




## 3—Control of Refrigeration

Experience with the control of absorption systems using ammonia systems indicates that the application of good instrumentation principles will provide a satisfactory system which is almost trouble-free. Some of the features of such a cycle are illustrated in the drawing above, wherein the suggested key points of control have been indicated, with supplemental control to be added at the preference of the operator.

Starting at the distillation column which strips water from an aqua ammonia solution, producing refrigeration grade ammonia overhead, there is installed a flow control for reflux. This is in contrast to some recommendations which have been made to use differential pressure control. Experience has shown that what is possible theoretically is not practical.

This situation is due primarily to an insufficient concentration change and correspondingly negligible temperature differences, as well as the unpredictable effects of subcooling. Differential temperature would undoubtedly work satisfactorily for systems subject to wider fluctuations in overhead purity.

Use of the flow control requires elevation of the overhead condenser sufficiently high to allow a small working head for the control valve. This can be 10 to 15 ft., with care in selection of the valve.

Flow control on the feed and level control on the forwarding bottoms has proved quite satisfactory. This is in contrast to recommendations to operate feed by level control and bottoms by flow control.

Remote pneumatic hand flow control of cooling water to overhead condensers allows maintenance of a uniform temperature and pressure without some of the disadvantages observed for automatic control for constant temperature of outlet liquid.

One other real control point is the liquid anhydrous ammonia as it is pressure- or level-regulated into the evaporator using the refrigeration of the system.

## 4—High Pressure Gas Flow

The problem was one of gas flow measurement at pressures in the 5000-psi. range and higher. Various methods were studied, with the impeller-type flow sensing cell appearing to have the primary device characteristics required.

It was desired to measure and record two flows on a single recorder chart, with a choice of selection of either one of the flows as a pneumatic control device. Since the controller was to be located in an electrically hazardous area, electronic instruments were not considered.

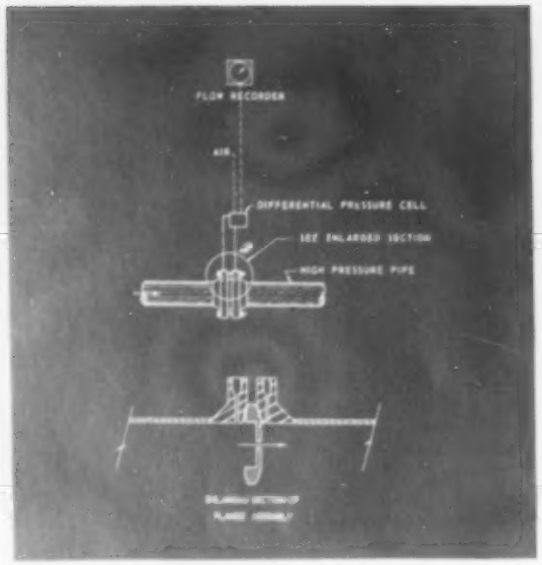
The problem was handled by the use of flow cells as primary elements installed directly into the high pressure piping. The output voltage from each cell was fed into converters, then through electrical conductors to electro-pneumatic units located near the main control panel (see drawing).

These units are of the servo electrical-pneumatic transducer type, converting microamperes into pneumatic pressure signals. With this scheme, the pneumatic signals were fed directly into a conventional two-pen, recording receiver-controller. Control point is selected manually by the operator.

After satisfactory operation of this system has been proved, it is expected other units of a similar type will be in demand. The advantages of the system are: simplicity, speed of response, ease of servicing, and safety. With electrical transmission, air piping is omitted, and distances do not present time lags as in conventional pneumatic transmission. There is no physical connection between the flow sensing coil outside the high pressure piping and the cell inside.

---

The information in this article is based on a paper, "Developments in Instrumentation by the Petrochemical Industry," by R. G. Marvin, W. L. Stuart, G. W. Lunsford, and E. E. Ludwig, Dow Chemical Co., Freeport, Texas, and scheduled for presentation Sept. 25-28 at the Petroleum Mechanical Engineering Conference of the American Society of Mechanical Engineers, New Orleans, La.




## 5—Relative Flow at High Pressure

Today, measurement of gas flow at high pressures has been a rather difficult service for instruments.

A problem in the range of 3000 to 9000 psi. proved quite challenging. Instrument manufacturers apparently could not offer any equipment as a solution.

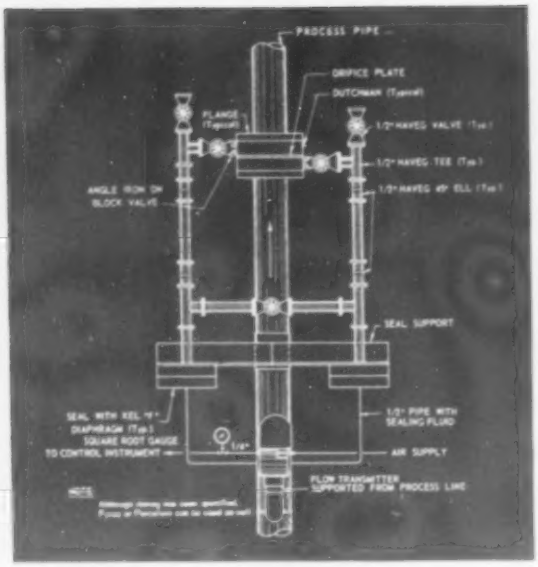
It became immediately evident that the complete development of an *accurate* instrument was impractical economically. It was necessary to settle for a *relative* flow-quantity measurement, since a control point could be established on the relative changes in flow as long as the approximate accuracy of the operation was known. This accuracy could be obtained by calculation from the speed and capacity of the reciprocating compressors.

With the assistance of a flange manufacturer's technical service group, it was decided to drill and tap the existing flanges in the high-pressure piping system where flow was to be measured. Calculations indicated that drilling ⅛ or ¼-in. diam. holes radially through the flange would not affect the safety of the flanges. The taps were not exactly in the positions required by best practice. However, they were placed in the only locations possible. After installation, the accuracy was checked out at ±7%.

The lens-type gasket was being used in the process piping. A blind gasket was used to fabricate the orifice, and was installed as shown in the drawing with no change in piping system dimensions.

In operation, one flow is compared with another which is parallel and which fluctuates in a somewhat similar manner. Controls can be established from any selected point and should then give relative readings. The pressure differential of the flange taps is picked up by a high-pressure differential-pressure transmitter, and recorded pneumatically in the control room.

Controls are not automatic, but rather are operated as reference points on the flow charts of the orifices. Control valve adjustment to keep the systems balanced is by pneumatic remote hand valve operation.




## 6—Measuring Corrosive Liquid Flow

The problem of metering a highly corrosive liquid at a high flow rate has been solved by use of a sealed differential-type meter. Normally, corrosive flow measurement is handled in one of two ways—either a pneumatic transmitting rotameter or a purged flow meter transmitter.

A rotameter of porcelain construction was first investigated. However, the cost for the size needed seemed too high. The idea of a purged flow meter was discarded because no suitable purging material was available at or near the meter.

Investigation revealed that a standard force balance type of small displacement meter could be so sealed as to prevent the corrosive liquid from coming into contact with the meter (see drawing).

The main components of the installation follow:

1—A force balance meter transmitter.

2—Two seals with diaphragms of suitable corrosion resistant material.

3—Two "dutchmen" (spacers).

4—An orifice plate.

5—Necessary valves and piping.

With reference to the drawing, it is well to point out these facts:

1—Each seal diaphragm area is larger than the area of the diaphragm in the meter.

2—The seals should be at the same elevation. If not, an error will be introduced in the meter.

3—From meter to seal, the line is filled with ethylene glycol or a similar material.

4—A flange designed from angle iron replaces the usual flange on the dutchman side of the block valve. This was done to enable a straight-through pressure tap to be made and to improve the mechanical strength of the valving at the dutchman.

Accuracy of this arrangement depends upon care in the installation and in sealing. It should be 1-3%.

# Do You Know These Words?

**By B. H. WEIL**
***Manager, Information Services***
***Ethyl Corp. Res. & Engrg. Dept.***
***Detroit, Mich.***

*A regular department intended to help administrators and operating men alike keep abreast of technical names and processes in the petrochemical field.*

### Sorbic Acid

**Sorbic acid**, pronounced "**sore**-bick **ass**-id," is a white, crystalline solid which is an interesting new, nontoxic "antimycotic" (yeast and mold inhibitor) now being used in increasing quantities by the food-processing industries. Cheese, chocolate syrups, cake toppings, and citrus products are only a few of the many types of foods in which sorbic acid is finding use. It has the formula $CH_3—CH=CH—CH=CH—COOH$, giving it the chemical name of "hexadienoic acid" (a six-carbon-atom acid which has two double bonds).

It has been known since World War II that sorbic acid could be used as an upgrader of cheap drying oils, but difficulties in (and the cost of) its synthesis, even then from petrochemical intermediates, kept it from finding large-scale use. Now, however, recent discoveries on its utility in foods have been coupled with a new method of synthesis.

According to the literature, sorbic acid is being produced by the catalytic oxidation of hexadienal, which in turn is now being produced by the interaction of acetaldehyde. This intermediate is itself a petrochemical, being produced from ethylene, acetylene, or the oxidation of propane and butane—in other words, from cracked refinery gases, natural gas, or LPG.

Being a highly reactive chemical (as an acid and also a diolefin), sorbic acid seems certain to find many other uses; it already is being used as a resin intermediate. While it is more expensive per pound than sodium benzoate as a food preservative, much less of it need be used; moreover, unlike sodium benzoate, it is metabolized in the body, and even has some food value. Not many petrochemicals can be eaten; here is one which can.

### Nitroparaffins

**Nitroparaffins**, in the research and development stage for over 20 years, have at last joined the ranks of commercial petrochemicals. Pronounced "**nye**-trow-**pahr**-aah-fins," the initial products are derived by the vapor-phase nitration of propane gas at high temperature and, specifically, include: nitromethane, nitroethane, 1-nitropropane, and 2-nitropropane. They are liquids which boil at temperatures somewhat above that for water, and they are slightly heavier than water per unit volume.

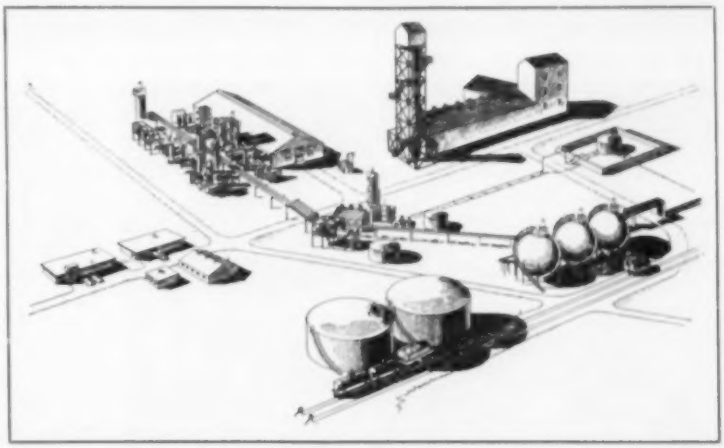
The nitroparaffins have been in semi-commercial production for 15 years, during which time over 2000 derivatives have been prepared. As can be gathered from this fact, these chemicals are important intermediates for the synthesis of other chemicals, and a considerable portion of the output of the new plant will go into their manufacture. In themselves, the nitroparaffins are powerful solvents for the cellulose plastics and other resins used in coatings, and for many dyes, and are used as selective solvents, as ingredients of special racing and model-engine fuels, as propellants, and as ingredients in synthetic-finish removers.

Derivatives of the nitroparaffins find use as (or in the manufacture of) insecticides, explosives, photographic chemicals, pharmaceuticals, emulsifying agents, textile specialties, curing agents for epoxy resins, dye intermediates, etc., etc. The list is legion.

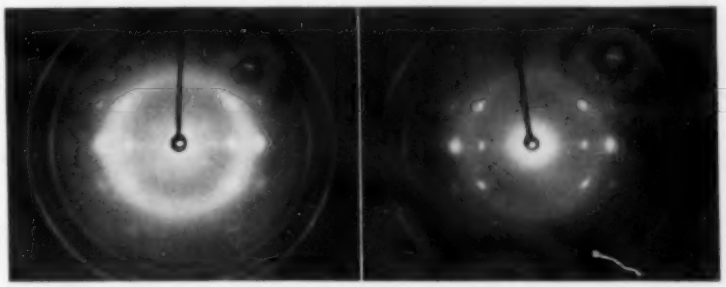
Nitroparaffins are true petrochemicals, being derived from propane and nitric acid (the latter, in turn, being produced from natural gas). Other members of the family and other descendants are scheduled for eventual production, so the petrochemical industry has really welcomed a host of relatives to its midst.

---

***NEWS in VIEWS . . . . . Synthetic Firsts in the Spotlight***



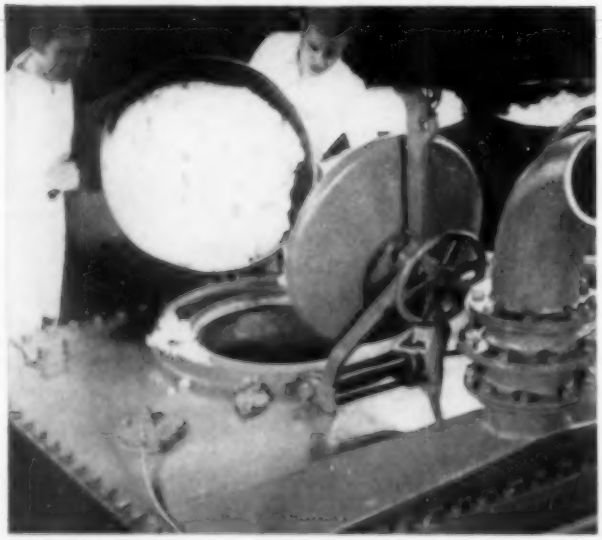
**FIRST AMMONIA-FROM-NATURAL-GAS PLANT** in the South Atlantic states will start operations at Savannah before the end of 1956. Southern Nitrogen Co.'s plant will convert its own production of 250 t/d of ammonia into nitrogen solution for fertilizers.



**FIRST SUCCESS IN SYNTHESIZING CRUDE RUBBER** is shown in these X-ray diffraction photos of rubbers with the same molecular structure. At left is the structure of natural rubber, at right, sample synthesized by B. F. Goodrich Research Center.

# specify Enjay for fast-paced sales

IN PETROLEUM (*Motor Oil and Gasoline Additives*)



IN CHEMICALS (*Plastics*)

IN SURFACE COATINGS (*Paint, Varnish, Lacquer*)

**PETROLEUM**
PARAROX
PARATONE
PARAFLOW
PARAPOID
PARADYNE
PARATAC
PETROHOL
Methyl Ethyl Ketone
Dewaxing Aid
Ethyl Ether
Isopropyl Ether
Reference Fuels

**RUBBER**
ENJAY BUTYL
VISTANEX

**SURFACE COATING**
PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Secondary Butyl Alcohol
Secondary Butyl Acetate
Isopropyl Acetate
Acetone
Methyl Ethyl Ketone
Dicyclopentadiene
Ethyl Ether
Isopropyl Ether
Naphthenic Acids
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol

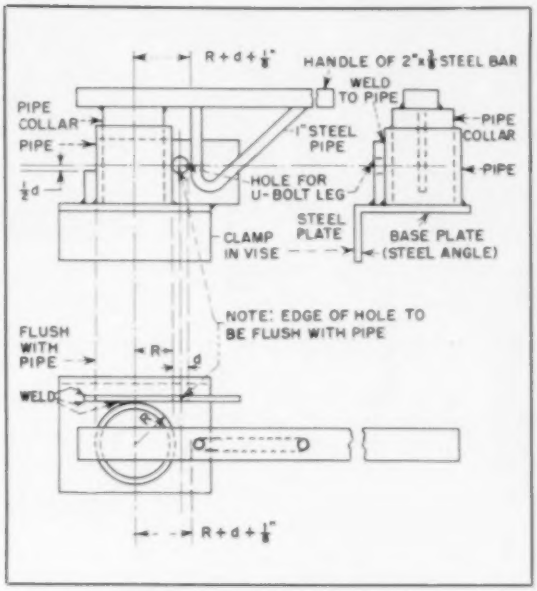
**CHEMICAL**
PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
Dicyclopentadiene
Isoprene
Butadiene
Ethyl Ether
Isopropyl Ether
Tetrapropylene
Tripropylene
Aromatic Tars
Benzene
Acetone
Methyl Ethyl Ketone

Rely on Enjay for top quality in your product, the kind that makes for growing demand and fast-paced selling. The Enjay Company supplies the petroleum, surface coating and chemical industries with a complete line of uniform, high quality petroleum chemicals backed by 35 years of *proved* results. You can also depend on Enjay for leadership in research and for expert technical assistance in developing new or improved products through chemistry. *Next* time, call Enjay for your chemical needs.

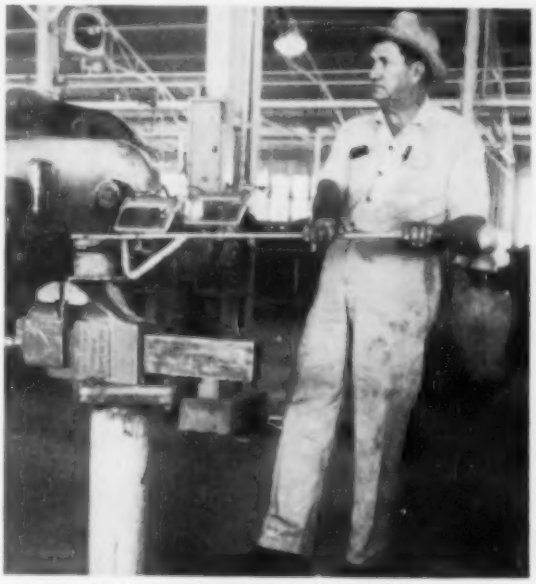
ENJAY

***35 successful years of leadership in serving industry***

**Enjay Company, Inc. · 15 West 51st St., New York 19, N.Y.**




**HOW TO MAKE JIG** to form U-bolts



**ONE TURN MAKES A U-BOLT** with this jig

# *Simple Jig Speeds Making U-Bolts*

THE Cosden Petroleum Corp. refinery at Big Spring, Texas, uses a lot of "U"-bolts in pipe sizes ranging from a half inch to 18-in. which, although relatively standardized within the plant itself, may or may not conform to commercially stocked sizes. Making them by the time-honored method of wrapping a threaded bar around a section of appropriately-sized pipe usually results in damaged threads, especially in the smaller sizes which cannot be threaded afterwards. Quite often, also, the legs of the "U" have to be straightened after forming, increasing the possibility of damaging the threads.

The shop blacksmith developed a selection of jigs for forming various sizes of U-bolts which have none of these objections. Moreover, cut and threaded lengths of bar stock can be run through the jigs in almost production-line fashion, making the chore into a simple, routine affair. One of the jigs and its developer, Dick Stuteville, are shown in action above.

The jig basically consists of a short length of the proper size pipe for the U-bolt desired, welded to a base plate which may be made from steel plate or a convenient length of angle-iron, into which the forming handle is fitted by means of a pipe collar, which acts as a pivot, or fulcrum of a lever. The arrangement is shown in the drawing. The size illustrated uses a 3-in. length of 4-in. pipe as the forming jig.

The handle is made from ⅜ by 2-in. flat steel bar, the length depending on the maximum diameter of round bar to be bent into U-bolts; 48-in. for this illustration. It is welded to the pipe collar which slips into the pipe on the base plate. The resulting pivot, or bearing, should be lubricated for ease in turning.

A bending bar is attached to the handle. This is fabricated into a 45° angle and welded into place with one leg vertical to the handle. This is the part which forces the round bar into the U-shape by bending it around the pipe. Distance between it and the pipe is equal to the diameter of the U-bolt bar stock plus approximately ⅛-in. working clearance.

A bending stop is made from a section of steel plate 3x⅜x6½-in. long welded to the steel pipe and also the base plate. A hole slightly larger than the largest size of U-bolt bar stock to be used (here ⅝-in.) is drilled through it as shown in the drawing, so that the inside edge of the hole is flush with the edge of the 4-in. pipe. This holds one leg of the U-bolt during forming. The other end of the plate should be notched so that the vertical edge of the notch is flush with the other side of the pipe and the bottom flush with the bottom edge of the hole. This prevents excessive bending of the U-bolt during forming and keeps the legs in the same horizontal plane. The notch may be sawed out after the plate is welded.

U-bolts are made by putting one of the threaded ends in the hole, the handle being against that side of the bending stop, and simply pushing the handle around until the other leg of the U-bolt is firmly against the other end of the bending stop.

A little experience will indicate how far to push stock into the jig to form a bolt with legs of equal length and raw stock chalked at this point. Once this distance is determined, U-bolts can be formed as rapidly as the stock can be positioned and the handle pushed through the 180° arc and returned.

Since the threaded sections of the belt are never in contact with the jig during bending, they are not susceptible to damage unless one end is carelessly rammed through the hole. If the jig is accurately assembled it is not necessary to "spring" U-bolts formed on it when they are installed.

now...

more effective
and economical

ENTRAINMENT SEPARATION

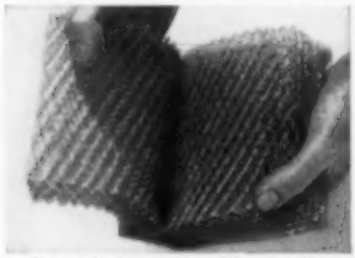
with the

NEW HI-THRUPUT HERRINGBONED MIST ELIMINATOR

Check these important points:

1. Half the pressure drop of Standard Mist Eliminator.
2. Safe operating limits — 10% to 12% higher velocity.
3. Entrainment removal practically 100% over wider operating range.
4. Three to four times longer on-stream life under coking conditions or where solids are present.
5. Lower cost — wires repositioned by Herringbone Fold*.

*U.S. Patent No. 2,565,846, Aug. 28, 1951



These photos show the difference. Full explanation given in our Booklet ME-5.

Send for Revealing Booklet ME-5. Learn how repositioning wires by patented Herringbone process and change in size and contour of mesh openings make this new Mist Eliminator more effective and economical.

METAL TEXTILE CORPORATION
Roselle, New Jersey

Metal Textile Corporation of Canada, Ltd., Hamilton, Ont.

**STEEL OVER-ALL COVER** protects electric welding machine controls

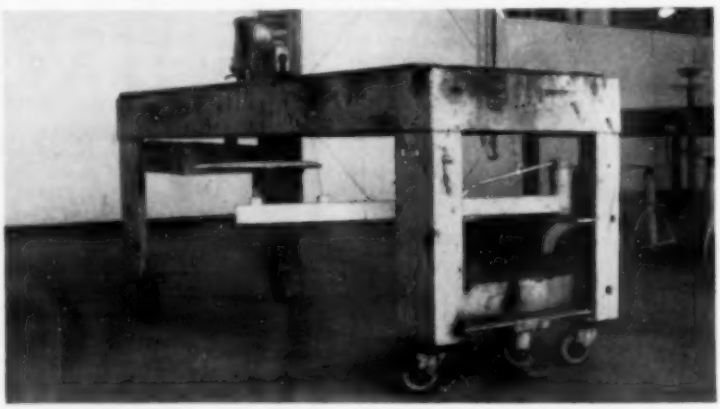
**STORAGE COMPARTMENT** at end of cover allows accessories storage

## Covered Welders Are Safe and Handy

THE electric welding machines in Socony Mobil Oil Co.'s East Chicago, Ind., refinery have been "covered" by metal boxes. These covers prevent the danger of accidentally brushing against the amperage controls, and furnish an area in which extra cable electrodes, goggles, etc. can be stored, also providing shelter against weather when the machines are located on outside jobs.

One end of the machine has a large spool on which slack power cable can be wound. The other end has shelves for the aforementioned storage of small items.

The three small swinging doors to the electric welder covers (spool, shelves, and controls) can be padlocked in the event that it is necessary to keep unauthorized persons out of the equipment.



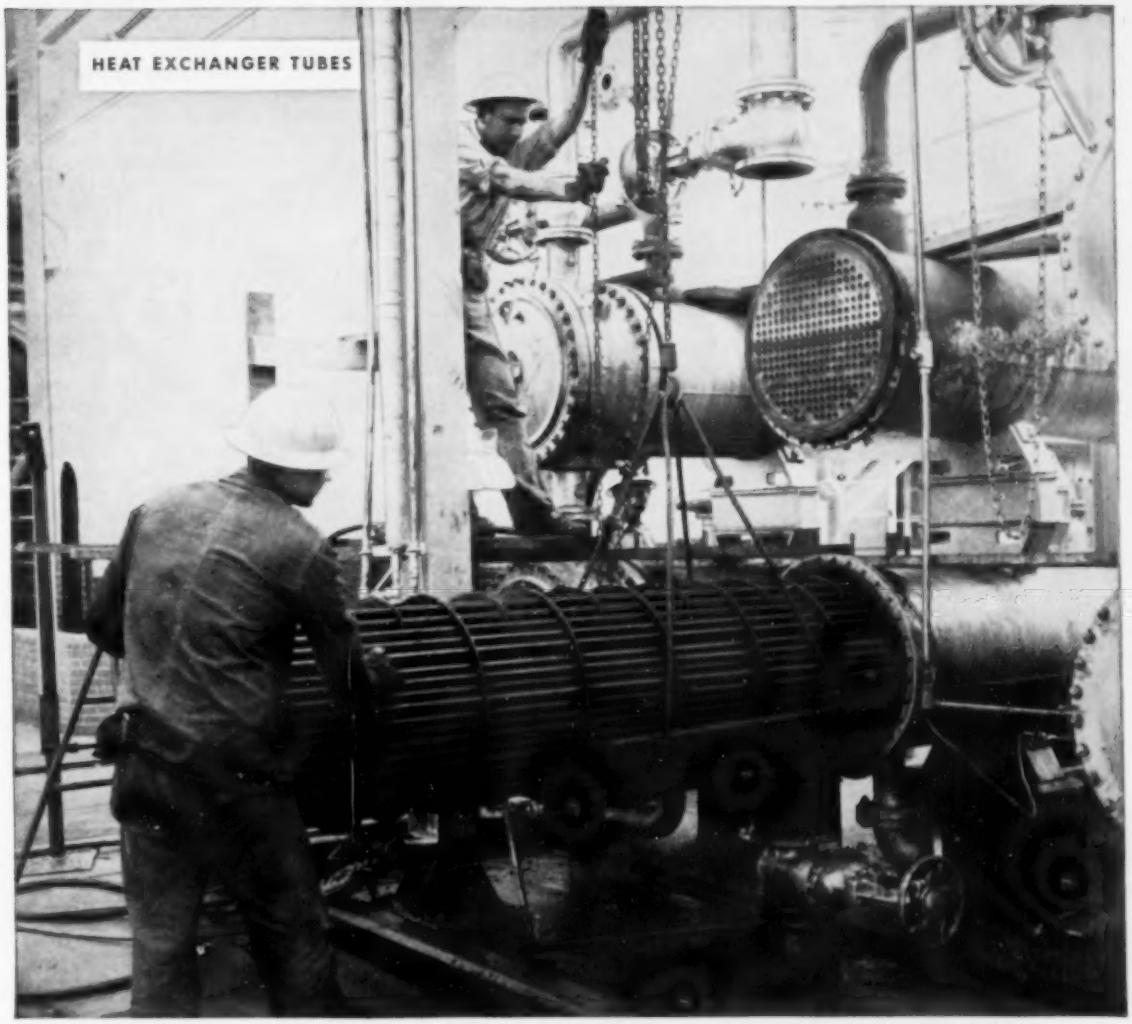
**HOMEMADE WELDER'S WORK-BENCH** is sturdy and neat, but not gaudy

## Easy-to-Build Welder's Bench

WELDER'S work-benches in the main shop at Cosden Petroleum Corp.'s Big Spring are not "things of beauty" but they are comparatively "a joy forever," combining as they do the attributes of great utility, mobility, sturdiness and convenience.

Home-made, the only commercially-made parts of the work benches are the casters, vise and footbrake which anchors the table when movement is not desired; the rest came from the scrap-pile.

The bench has a top of ¾-in. steel plate welded to sides and legs made from wide, half-inch steel angles (one leg of the angles supports the top, which is welded in place on the underneath side and the other leg is welded to the angles forming the legs). A square of plate steel is welded onto the legs to form a foot, and the casters




**PERFORMANCE RECORD** of these tubes under actual operating conditions is now a part of Anaconda's extensive collection of case histories.

# Use of Anaconda Cupro Nickel, 10%-755 Tubes in Texas refinery may answer your tube problem

Imagine a collection of tube performance case histories that can answer many of the corrosion problems you face!

Our files bulge with such a collection. Here is experience accumulated over almost a century. Here are detailed records of tube performance under hundreds of actual operating conditions.

We can put the information in these files to work for you at once—to help you select the one best alloy for your job.

Here's a case history we are now adding—the use of ANACONDA Cupro Nickel, 10%-755* Tubes in the Port Neches Refinery of a major oil producer.

These tubes—in use two years—cool heavy gas oil in an Alco Exchanger on a Crude Pipe Still Unit. Gas oil at about 500°F.—mildly corrosive—comes in contact with the outside of these tubes. Brackish river water—with a high salt content—circulates through the tubes. Yet the tubes show no sign of corrosion.

**CUPRO NICKEL,** 10%-755 resists corrosion almost as well as Cupro Nickel, 30%-702, yet it costs much less. Polluted sea water and sea water with entrained air—even at relatively high velocity—have little effect on this alloy.

**Help for your tube problem.** No one tube alloy serves best under all conditions. Your problem is one of choosing the right alloy for the job. Let Anaconda's Technical Department help you. Write, outlining your operating conditions, to Dept. TD. *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

*U.S. Patent No. 2,074,604 54109

**ANACONDA®**
**Tubes and Plates**
**for Condensers and Heat Exchangers**

are bolted on. Casters on the legs at one end are fixed; those on the other end are swivel-type. To support the foot brake, detail of which is shown in the accompanying photograph, another angle was welded between two of the legs. It works exactly like a step-on door-stop.

The welder's swivel stool is a piece of channel-iron, long enough to allow the craftsman to use it from either side of the table. A piece of pipe is welded to one end, and fits over a short piece of shaft or pipe welded to a bracket fastened to one of the legs at a convenient height. A brace of ⅜ or half-inch pipe is welded to the swivel and the channel. One or two holes are drilled in the channel web at the other end, over which nuts are welded. The seat may be placed in either of the two holes in the channel web to allow positioning the seat at the most convenient working position.

The seat is made of quarter-inch steel plate, welded onto a threaded shaft 6-in. or so in length, fitting the nuts on the channel to permit height adjustment. A pin may be provided on the threaded shaft to prevent screwing the seat out of the nut and perhaps causing a foot-injury.

At the opposite corner of the bench, small steel angles are used to form the support for a box containing bins for up to three types or sizes of welding rods. The angles are welded to one of the legs and, with straps, to the underside of the top. The box for the rods is made of wood.

Holes of various sizes may be drilled in the sides of the bench to permit bolting the work in this manner for convenience. The table may be connected to form a ground for arc-welding. The vise is similarly bolted over one of the table legs.

The work table shown is sturdy enough to support an automobile, although the casters probably would not take the load.

**Are You Hep?**

Are you keeping a file of PETROLEUM PROCESSING Plant Practice Tips? Many refinery men do and find them to be valuable reference material.


**TRACIT**

**THERMAL CONDUCTING CEMENTS SAVE 75% OVER JACKETING**

Valve with steam tracing

Same valve with TRACIT applied

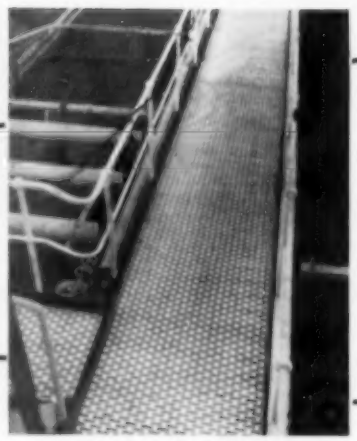
TRACIT is a thermal conducting cement that eliminates jacketing on pipes, valves and pumps. It is applied over steam and electrical tracings wherever it is desirable to maintain temperatures by the addition or subtraction of heat within the range of minus 115 to 800° F. TRACIT is equally effective on systems that are alternately heated and cooled.

TRACIT-200 applied with caulking gun

TRACIT-200 is a special thermal conducting cement applied with caulking gun. The excellent thermal conductivity, ease of handling and application, thermal shock resistance and low cost make TRACIT-200 ideal for traced pipe and tanks.

*Reduce costs on valve, piping and pumping installations. Write for descriptive bulletin today.*

**CHEMAX MFG. CO.**
NEW CASTLE, DELAWARE



**ALUMINUM GRATING WALKWAY & HANDRAILING**

A typical installation frequently used in the petroleum industry.

*See us also for:*

- Pressure Vessels
- Heat Exchangers
- Storage & Processing Tanks
- Towers
- Gratings

Our pressure vessels and tanks are designed and built to comply with the requirements of the ASME code and we are authorized to apply the appropriate symbols.

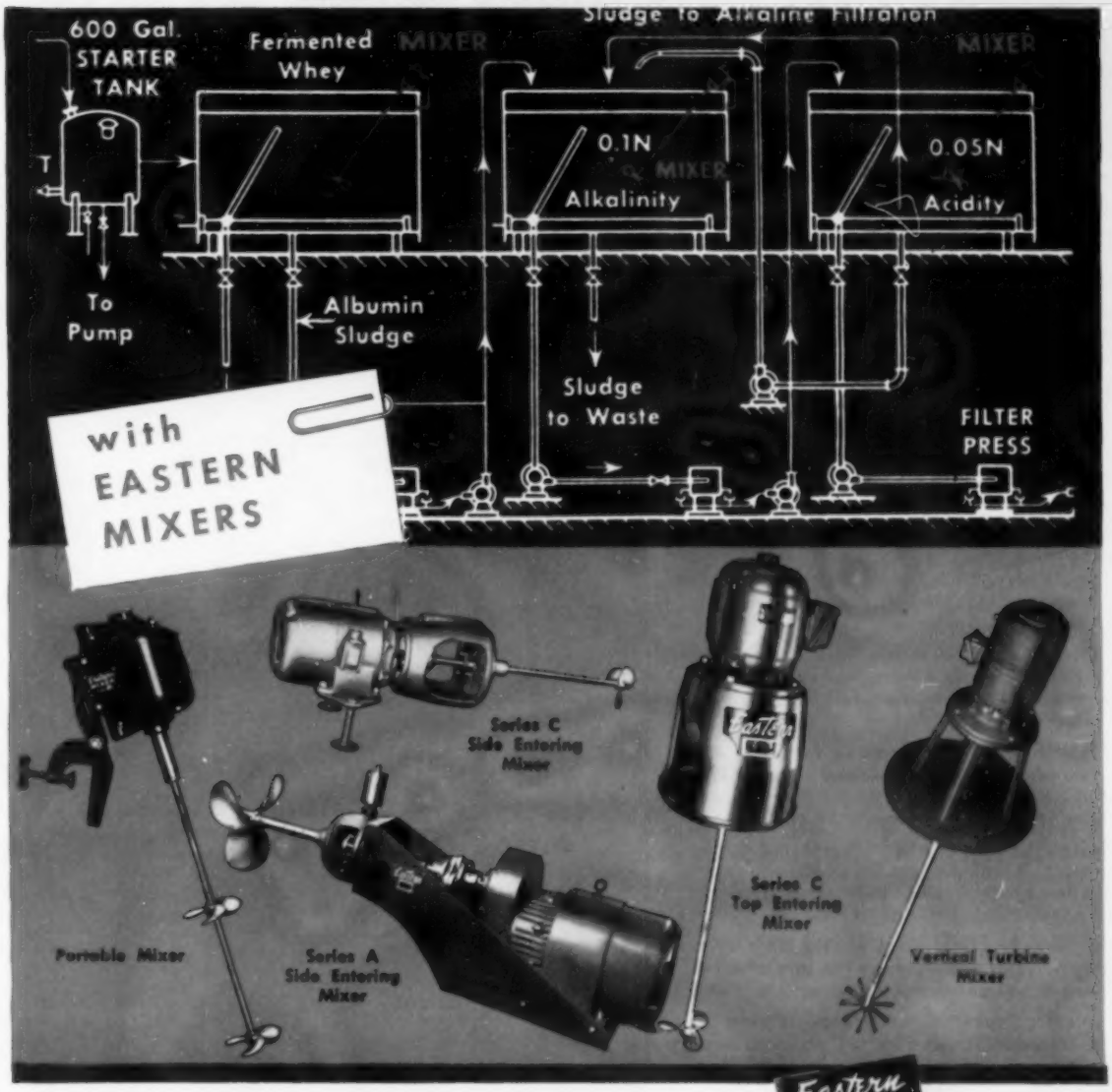
**WASHINGTON ALUMINUM CO., Inc.**
**BALTIMORE 29, MD. ● ARBUTUS 2700**

NEW YORK: Murray Hill 7-0926
BOSTON: Liberty 2-7917
CLEVELAND: Yellowstone 2-6107
HOUSTON: Blackstone 6388
MOBILE: Hemlock 2-4466
NEW ORLEANS: Raymond 9744
SAN FRANCISCO: Yukon 6-2803
SEATTLE: Main 8930




*(To obtain more data on advertised products see page 1628)*

# RELIABLE FLUID MIXING in PROCESSING




Eastern's Mixers are designed to meet the needs of today's chemical and industrial processes. Many types are available to satisfy all conditions of fluid consistencies and tank sizes. Selection may be made from a wide range of horsepower, speed, and construction materials. Motors with various voltage ratings and enclosures are also furnished.

## PORTABLE MIXERS

Series H at 1725 R.P.M., Series S at 1125 R.P.M., and Series G at 420 R.P.M. are available in motor ratings from 1/20 to 5 H.P. Also available are special speeds, variable speeds, as well as air driven models.

## TOP AND SIDE ENTERING

Series A, extra heavy duty for large tanks, are available in side entering units only within a range of 5-30 H.P. with standard speeds of 280, 420, and 1150 R.P.M.

Series C, for average tank capacities, are available in sizes of ¼ to 10 H.P. at these standard speeds: 1725 R.P.M. (up to 5 H.P.); 1140 R.P.M. (up to 10 H.P.); 420 R.P.M. (up to 7½ H.P.); 280 R.P.M. (up to 5 H.P.). Available in both horizontal and vertical models.

## TURBINE MIXERS

Eastern's Top and Bottom Entering Turbine Mixers find particular application where liquid blending requires gentle, yet thorough agitation.

Models are available in sizes from ¼ to 40 H.P. Standard speeds are 56, 68, 84, 100, 125, 155 R.P.M.

*For 3 bulletins covering Eastern Mixers, request Catalog Series 29.*

**Eastern INDUSTRIES, INC.**
**Mixer Division**
**Regent St., Norwalk, Conn.**


*(To obtain more data on advertised products see page 1628)*

# 10 REASONS WHY

## LEADING REFINERS RELY ON KONTOL FOR PROTECTION AGAINST CORROSION

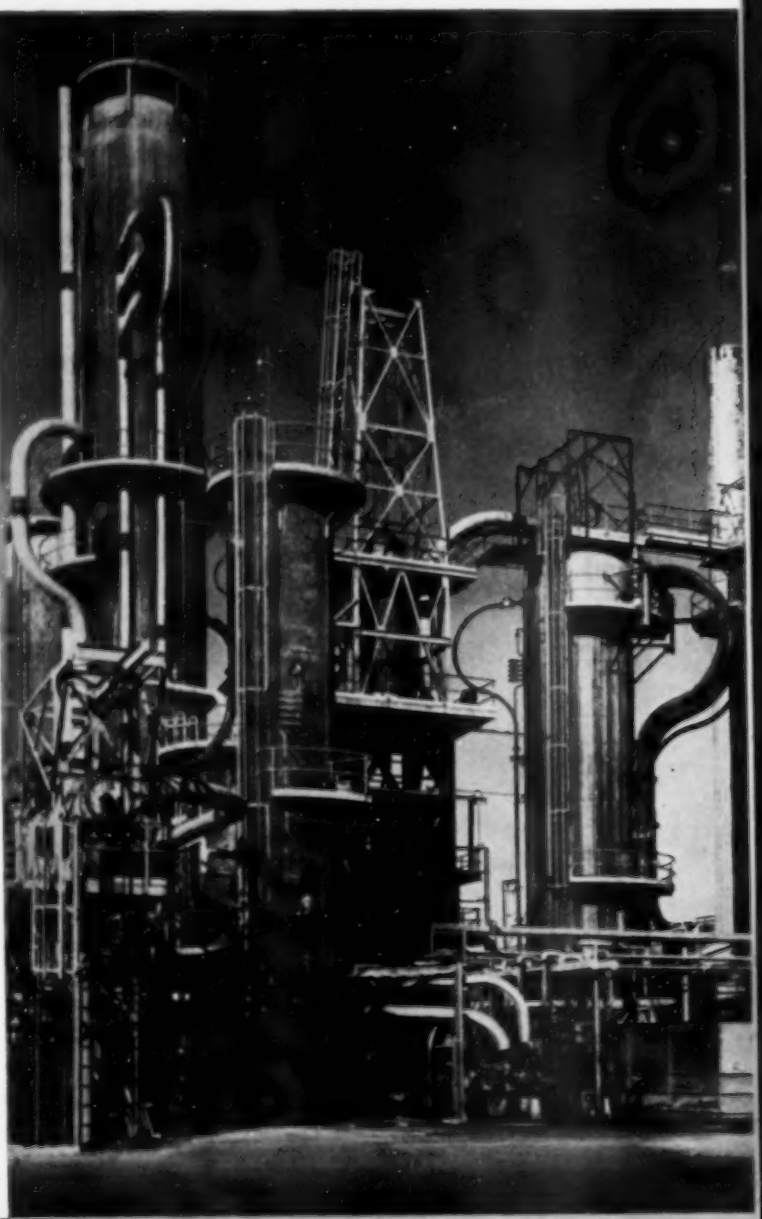
1. Kontol protects against attack by organic and inorganic acids and brines which cause corrosion, hydrogen blistering and embrittlement.
2. Kontol effectively protects steel, nickel and stainless alloys of steel, monel, brass and admiralty metal.
3. Kontol offers detergent action as well as inhibitive properties. It also assures the advantages of operations with clean units and flow systems.
4. Kontol has no adverse effects on distilled product properties such as distillation end point, gum formation, anti-knock rating, ash, etc.
5. Compared with the replacement costs of the equipment it protects, the cost of Kontol protection is negligible.
6. Kontol is convenient and safe to handle, easy to apply. No gloves, masks, goggles, aprons or extraordinary safety precautions are necessary.
7. Kontol is available in many formulas, to meet varying requirements. It can be oil soluble; oil soluble and water dispersible; water soluble and oil insoluble.
8. Kontol, in the appropriate formula, is miscible in all proportions with aqueous alkaline agents and can be injected through the same system.
9. The Tretolite commercial testing staff will carry on tests to determine the rate of corrosion in your refinery, at no cost to you.
10. Kontol has been proved to provide protection against corrosion in

CAT CRACKER FRACTIONATORS
CRUDE STILLS
DEPROPANIZERS
DEBUTANIZERS
DEPENTANIZERS
GAS RECOVERY SYSTEMS
ABSORBERS
STABILIZERS
PLATFORMERS
REFORMERS
DESULFURIZATION SYSTEMS
VACUUM TOWERS
ALKYLATION PLANTS
COKING SYSTEMS
DEWAXING SYSTEMS
ALKANOLAMINE SWEETNERS

TRETOLITE COMPANY
KONTOL
SAINT LOUIS LOS ANGELES

Chemicals and Services for the Petroleum Industry

DESALTING • CORROSION INHIBITING • WATER DE-OILING
DEMULSIFYING • SCALE PREVENTION • ASPHALT ADDITIVES



If you have a corrosion or fouling problem, get in touch with the Tretolite refinery service engineer in your area or write to

**TRETOLITE COMPANY**
A DIVISION OF PETROLITE CORPORATION

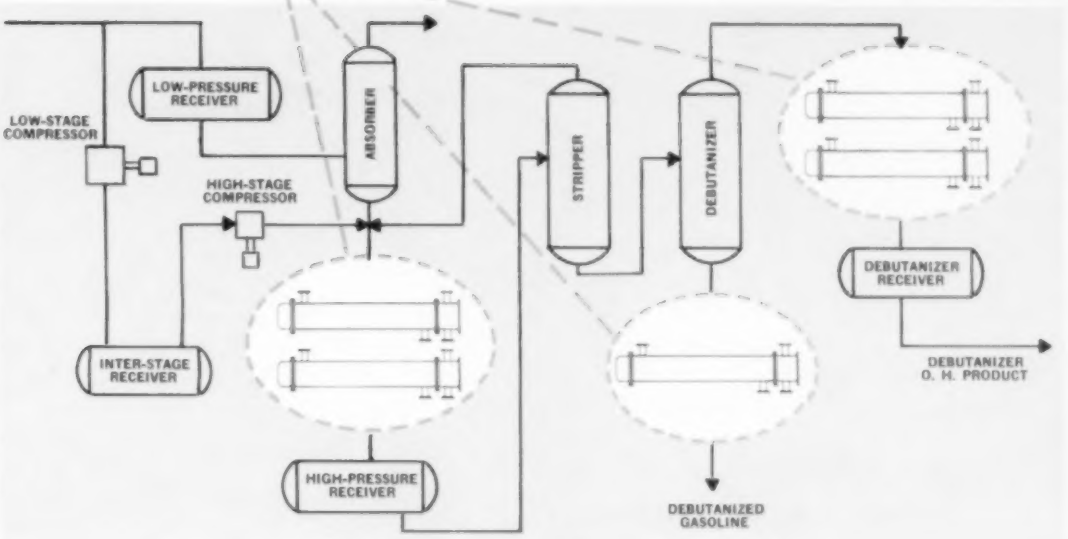
369 Marshall Avenue, St. Louis 19, Missouri
5515 Telegraph Road, Los Angeles 22, California

KB 59-4

*No. 10 of a series of advertisements showing new opportunities in heat exchange design.*

# NEW GAS CONCENTRATION UNIT GOES ON STREAM

## *using Wolverine Trufin* Type S/T Condenser Tube*




When it comes to picking a winner one of the best guides is—PAST PERFORMANCE.

That's the yardstick used by a large Midwest Refinery. As a result, when their new gas concentration unit went on stream recently, five of the heat exchangers were tubed with Wolverine Trufin Type S/T Admiralty Condenser Tube.

From previous experience this company knew that by using Trufin Type S/T they could *increase capacity, design smaller units* and *effect substantial savings in space requirements.*

Take a good look at the accompanying flow chart. It shows exactly how the following five heat exchangers were used:

1. High Pressure Cooler (two exchangers) Cooling high pressure gas system.
2. Debutanizer Overhead Condenser (two exchangers). Condensing and sub-cooling butane and lighter hydrocarbons.
3. Debutanizer Bottoms Cooler (one exchanger) Cooling debutanized gasoline.

If you are designing new heat exchange equipment, Trufin Type S/T can serve you as effectively as it does this company. Because its fins are an integral part of the tube, Type S/T has more than twice the heat transfer surface of prime surface tube—transfers more BTU's per foot of tube. The result is increased capacity plus a gratifying saving in headers, baffles, tubing, labor and space requirement.

When retubing existing equipment Trufin Type S/T gives the same boost in performance and achieves the same economies. It is mechanically interchangeable with prime surface tubes of the same size. It can be rolled or brazed into headers by conventional methods. Trufin Type S/T is available in a wide range of sizes and alloys in copper, aluminum and electric-welded steel.

Remember—when designing new equipment or retubing existing units—specify Wolverine Trufin Type S/T. You'll achieve new standards of efficiency and economy. For factual Trufin case histories and helpful design information, write today for your copy of the Trufin Opportunity Book.

WOLVERINE TUBE, 1441 Central Avenue, Detroit 9, Michigan.

*REG. U. S. PAT. OFF.

**WOLVERINE TUBE**
DIVISION OF CALUMET & HECLA, INC.
*Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes*

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

# THE WELD IS SOUND

Electric-welded steel tube is finding increasing favor in heat exchange and condensing operations particularly where low cost installations are desired. The following questions are typical of the many answered by Wolverine's Field Engineering Service.

**Q.** How sound is the weld in steel tubing?

**A.** With modern welding techniques the weld is as strong as the tube wall and has the same top quality as the steel from which the tube is formed.

**Q.** Does Wolverine electric-welded steel tube pass standard testing procedures?

**A.** You can be sure of that. Flattening, reverse flattening, expanding and flanging of tube sections assure constant weld quality. In addition, each condenser tube must meet hydrostatic tests well over a fibre stress of 20,000 psi.

**Q.** Is Wolverine Trufin* available in electric-welded steel form?

**A.** Yes! Wolverine manufactures integrally finned Trufin in electric-welded steel as well as in copper, copper alloys, aluminum and bi-metal. Incidentally, during Wolverine's exclusive finning process, electric-welded steel tube is cold worked while the integral fins are extruded from the tube wall—another graphic proof of the weld's ability to stand up.

**Q.** What do you mean when you say "Quality controlled from strip to finished product"?

**A.** Strip steel received by Wolverine must meet rigid specifications before acceptance. During the manufacturing process constant inspection insures that the tubing will meet Wolverine's high quality standards.

**Q.** Does your electric-welded steel tube have a brand name?

**A.** Indeed it does. In its prime surface form it is known as Wolverine Qualitube.* In its integral finned form it is known as Wolverine Trufin.

Wolverine electric-welded steel tube—either finned or prime surface—can help you realize new standards of low cost heat exchange efficiency. Next time you retube ask for a Wolverine quotation. Write, too, for your copy of the Wolverine Trufin Catalog.

*REG. U. S. PAT. OFF.

**WOLVERINE TUBE**
DIVISION OF CALUMET & HECLA, INC.
*Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes*

***Wolverine Trufin is sold in Canada under the Unifin Tube Co., London, Ontario.***

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.
EXPORT DEPT. 13 E. 40TH ST., NEW YORK 16, N. Y.

**Noel V. Wood** has been appointed process engineering supervisor for Mobay Chemical Co. Since 1952 Wood has been in the process engineering section of Monsanto Chemical Co.'s Organic Chemicals. Previously, he was with Hydrocarbon Research and Linde Air Products.

**B. H. Shoemaker,** formerly director of the hydrocarbon research division of Standard Oil (Indiana), has been named associate director of research. Dr. Shoemaker graduated from Hope College and Ohio University, joining Indiana Standard in 1930. He has been division director since 1950.

Succeeding Dr. Shoemaker is **A. P. Lien,** former assistant director, who joined the company in 1941 after graduating from Ottawa College and Ohio University. Other appointments in the research department at Whiting include: **C. E. Adams** to senior research associate; **A. A. Harban** to section leader; and **R. E. Van Strien, M. C. Hoff** and **John B. Malloy** to group leaders.

Mr. Dalton

Mr. Sinclair

**Swanton D. Dalton,** manager of Socony Mobil Oil Co.'s refinery engineering division, has been appointed to the newly-created position of asst. general manager of manufacturing in charge of technical coordination. Dalton, who holds degrees from Stanford and MIT, started work in 1933 with General Petroleum Corp., Socony Mobil's affiliate on the West Coast. He joined the parent company in 1940 as a process engineer and served in various supervisory engineering positions before becoming manager of the refinery engineering division and a member of the company's manufacturing committee in 1950.

**Edward L. Sinclair,** general manager of the company's refinery at Paulsboro, N. J., replaces Dalton as refinery engineering division manager. Sinclair joined Socony Mobil in 1938 following his graduation from the University of Michigan. He was assigned to the Paulsboro refinery, becoming asst. general manager in 1949 and general manager in 1950.

**BOB WIMMER'S** spare time is devoted to making a dog's life a better life. Here the Esso Research and Engineering senior technician calls on the foster home and "parent" of a dog he placed as chief of the county's American Society for the Prevention of Cruelty to Animals. A member since 1924, Bob became an enforcement officer in 1930, which makes this his 25th year of "active" volunteer work.

Mr. Cranston

**L. Erlis Cranston,** formerly asst. general manager, has succeeded Sinclair as Paulsboro refinery manager. Cranston started to work at the Augusta, Kansas refinery after graduating from Southwestern College in 1931, transferring to the manufacturing department in New York in 1950. The following year he joined the staff of the Paulsboro refinery, becoming asst. general manager in 1953.

**Henry H. Hewetson,** a director of the Standard Oil Co. (N. J.), has been elected a vice-president of the company. He has served with Jersey Standard affiliates as an engineer and as a executive in manufacturing and marketing, located in Canada, South America, Europe and the United States.

Hewetson was elected a director and vice-president of Imperial Oil, Ltd., in 1940, president in 1945, and chairman of the board four years later. He has been a Jersey Standard director since 1950.

**Ju Chin Chu** of Polytechnic Institute of Brooklyn has been appointed to full Professor of Chemical Engineering. Widely known as a distillation and process design engineer, he is an active consultant in petroleum refining and petrochemical industry.

**E. J. Fox,** plant superintendent of the Carbide and Carbon Chemicals Co. works at Texas City, has been promoted to assistant works manager, with headquarters in New York. He has been succeeded by **T. A. Wilker.**

Fox has been with the company since 1930, when he was employed

as a production engineer at South Charleston, W. Va. Subsequently he has been department head, chemical area supervisor, assistant plant superintendent at Texas City, superintendent of the butadiene plant at Louisville, Ky., and then plant superintendent at Texas City.

Fox took his B.S. degree in chemical engineering at West Virginia University, and was graduated in 1930.

Wilker, the new superintendent of the Texas City plant, was formerly assistant superintendent of vinylite and polyethylene production. This post has now been assigned to **L. L. Dintiman,** supervisor of the vinylite area.

Two new asst. managers have been appointed in the Fine Chemicals Division: **R. W. Eddy,** who has been product manager directing market development of chemical intermediates; and **J. J. Morris,** who has been product manager directing market development of Flexol plasticizers and stabilizers for vinyl resins.

Mr. Holloway

Mr. Swan

**Fred Holloway,** former assistant general manager of Esso Standard Oil Co.'s Louisiana Division, has been promoted to assistant general manager of Esso's East Coast Manufacturing Division.

He has been succeeded at Baton Rouge by **Donald W. Swan,** who was general superintendent.

Holloway went to Esso at Baton Rouge from Massachusetts Institute of Technology, where he received his Ph.D. in 1939, and worked first as a process engineer. Three years later he moved to the chemical technical service department and became its head in 1947. He was made head of the technical division in 1950, general superintendent of the refinery in 1953, and assistant general manager of the plant late in 1954.

Swan joined Esso following graduation from the University of Minnesota with a degree in chemical engineering in 1939. He was head of the technical service division before he became general superintendent.

Donald L. Ferguson and Daniel L. Hussey continue as assistant general managers of East Coast Manufacturing.

**Dr. E. Neil Shawhan** has been appointed manager of a new applied physics section in the manufacturing department of Sun Oil Co. **Einar T. Young** has been named assistant manager of the unit, which was originated to conduct studies on the efficiency of refinery technology.

In addition to solutions for some of the department's problems through use of the latest electronic devices and other techniques, the physics unit is expected to develop some new instruments for use in refining and research.

**K. D. Bowen** has been appointed vice-president and general manager of the Texas Butadiene & Chemical Corp., a new firm which will construct an alkylate-avgas and butadiene plant in the Houston area. **E. L. Green, Jr.,** is president of the firm.

Bowen was associated with Dow Chemical Co. for 17 years in various capacities, including manager of the Texas styrene plant. He joined Celanese Corp. of America in 1946 as manager of the Bishop, Texas, chemical plant. Later he was made manager of plant operations, and in 1953, director, manufacturing coordination.

**Dr. C. A. Stokes,** a director of Petro-carb, Inc., has been elected vice president and technical director. For the past 10 years Dr. Stokes has been director of research and development for Godfrey L. Cabot, Inc.

**M. L. Root** has been made assistant manager of the engineering department at General Petroleum Corp.'s Torrance, Calif., refinery. Root began with the company in 1928 as a clerk. In 1946 he became assistant to the manager of the engineering department at the Vernon plant, in 1949 construction engineer at Torrance, and in 1953 Root was moved to Ferndale, Wash., where he served as construction engineer while the refinery there was being built.

**Reid Brazell,** president of Leonard Refineries, Inc., has been reappointed to the refining panel of the Military Petroleum Advisory Board of the Department of the Interior. The board was reactivated in April of 1954 to provide the government with advice on strategic matters related to the petroleum industry. Members of the refining panel in addition to Brazell are as follows:

C. E. Davis, vice-president, refining, Shell Oil Co., chairman of the panel.

George L. Mateer, director, manufacturing and research department, Cities Service Petroleum, vice-chairman.

William R. Argyle, vice-president, manufacturing, Sinclair Refining Co.

George A. Davidson, director and vice-president, Standard Oil Co. of California.

W. M. Holaday, manager of laboratories, Socony Mobil Oil Co.

C. Stribling Snodgrass, an independent producer.

Charles E. Webber, technical advisor to the vice-president of production, Sun Oil Co.

**George Myers** has been appointed superintendent of the Catlettsburg, Ky., refineries of Ashland Oil & Refining Co. He was transferred from Canton, where he was operating superintendent of the refinery. He replaces **Walker N. Marx,** who has become the superintendent of the Canton refinery, succeeding **William B. Borst.** Borst has been transferred to the company's headquarters at Ashland. He was made superintendent at Canton in 1947.

Myers joined the company as a shift supervisor at Canton, later served as maintenance superintendent, and became operating superintendent in 1952. Before 1951 he was with Houdry Process Corp., and during World War II worked as a job engineer for E. B. Badger & Son. He has also been with Standard Oil of Ohio and Socony Mobil Oil Co.

Marx became superintendent at Canton in 1952. He began with the company in 1944 as an engineer, became shift superintendent and later operating superintendent. He came to Ashland from the Lago Oil and Transport Co., where he was in the processing department.

**Milburn J. O'Neal** has received Precision Scientific Co.'s award in petroleum chemistry for 1955. O'Neal is group leader of the analytical research group of Shell Oil Co. The award was made during the recent national meeting of the American Chemical Society.

**Donald Ferguson,** assistant manager of Esso Standard Oil Co.'s East Coast Manufacturing Division, has been appointed chairman of the security committee. It was organized in 1950 to plan measures for safeguarding vital records and assuring continuity of operations in the event of disaster.

The demand for higher octane gasoline is increasing rapidly and it is only a matter of time until you will be faced with meeting the challenge of 100 octane (plus) gasoline. Our prediction is that it will be earlier than you think.

Treco would like to help you, too! Get started now, in advance of competition. Call us to discuss your requirements. Remember . . . Treco designs, engineers and constructs — f a s t.

TRECO
REFINERY ENGINEERING Company
TULSA TORONTO


(To obtain more data on advertised products see page 1628)

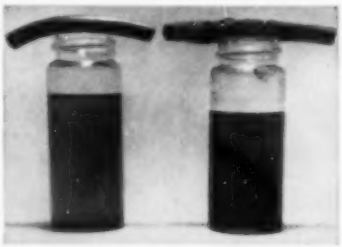
# *Avoid* **gel-clogged** *fuel line complaints with Du Pont Metal Deactivator*

A rash of complaints due to clogged fuel lines causes headaches among fuel oil refiners and marketers during any heating season. And, as you might expect, the fuel oil is often blamed for causing the trouble.

A careful study of the problem reveals that clogging generally occurs in the line leading from the fuel oil storage tank to the burner, or at the screen in front of the fuel pump. And this clogging is generally due to the formation of a *gelatinous* material.

### Copper causes the trouble

Since the feed-in line and the screen are often made of copper, they are a potential source of copper mercaptides which, if formed in sufficient quantities, become gelatinous in nature. You can assure better customer relations by protecting your oil against this gel formation with Du Pont Metal Deactivator in addition to Fuel Oil Additive No. 2, which guards against sludge.



*Left,* fuel and copper tubing stored for two weeks with 0.05 wt. % mixed mercaptans and 0.1 theory of Metal Deactivator. Right, fuel and copper tubing stored for two weeks with 0.05 wt. % mixed mercaptans without Metal Deactivator.

### Low-cost insurance

In most fuel oil stocks, Du Pont Metal Deactivator is highly effective in low concentrations (about 2 pounds per 1000 barrels). This means that you can adequately insure yourself against the harmful effects of copper and promote better customer relations at a cost of less than ½ cent per barrel.

Du Pont Metal Deactivator was originally developed to prevent copper from accelerating harmful gum formation in gasolines. It also has valuable application in kerosines, diesel fuels, turbine oils and jet fuels.

A booklet describing the properties, uses, and methods of addition of Du Pont Metal Deactivator is available. If you do not already have a copy, ask any of our representatives or regional offices listed below to send you one.

DU PONT
REG. U.S. PAT. OFF.

**Better Things for Better Living . . . through Chemistry**

# Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

*Regional Offices:*

NEW YORK, N.Y.—1270 Ave. of the Americas ... Phone COlumbus 5-2342
CHICAGO, ILL.—8 So. Michigan Ave. ... Phone RAndolph 6-8630
TULSA, OKLA.—P.O. Box 730 ... Phone LUther 5-5578
HOUSTON, TEXAS—705 Bank of Commerce Bldg. ... Phone CApitol 5-1151
LOS ANGELES, CALIF.—612 So. Flower St. ... Phone MAdison 5-1691

IN CANADA: Du Pont Company of Canada Limited—Petroleum Chemicals Division, 80 Richmond St. W., Toronto 1, Ont.
OTHER COUNTRIES: Petroleum Chemicals Export—Nemours Building, 6529—Wilmington 98, Delaware

By Peter J. Gaylor, Patent Attorney, Elizabeth, N. J.

# Obtain High Yields in Treatment Of Raw Cracked Gasoline

ONE of the problems of the present day, when research octane ratings are at their highest, is the treatment of raw cracked gasoline fractions to produce a finished gasoline of accepted storage stability and octane number.

Present specifications for commercial motor gasoline require that it pass an "existent gum" test in accordance with ASTM method D381, in which the gasoline must show less than 5 mg. per 100 ml. To meet desirable storage requirements commercial motor gasoline must meet the storage stability requirements set forth in ASTM method D910-48T, or D525-49. Also, the modern high compression engine demands the production of gasoline possessing a high octane rating, usually determined as "clear research octane number" in accordance with ASTM method D908-48T.

Various processes have been proposed for treating raw gasoline fractions that will result in gasoline acceptable for commercial use, and some of these have been successfully used. However, cracked raw gasolines are generally of moderate to high octane number, contain 10 to 50% by volume of aromatic hydrocarbons, and at least 20% by volume of olefins. Known methods for removing gum-forming constituents and improving the storage stability normally bring about the destruction or conversion of some of these unsaturated compounds.

The principal problem is that of lowering the existent gum content and improving the storage stability of cracked raw gasolines, while at the same time maintaining a high yield of finished gasoline and not impairing the clear research octane number. Heretofore known processes have not been able to solve the problem.

However, Hydrocarbon Research, Inc., in U. S. Patent No. 2,707,700 discloses a process which claims to give finished gasoline yields of more than 90% by volume, even when the raw gasoline contains a large percentage (5% by volume or more) of diolefins.

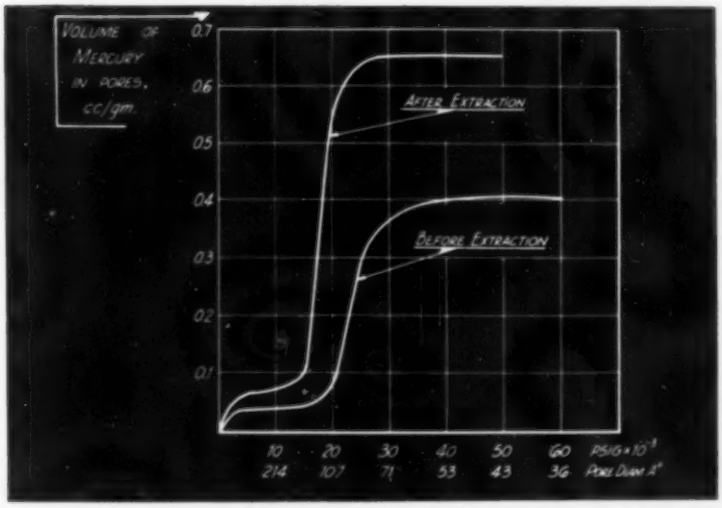
In accordance with the patent, a cracked raw gasoline fraction of unsatisfactory storage stability (i.e., failing to meet the commercial existent gum and storage stability requirements in accordance with ASTM methods D381 and D910-48T or D525-49, and containing at least 20% by volume of olefins) is introduced, together with hydrogen, into a treating zone maintained at a temperature of 800 to 925° F., preferably at a temperature of about 825 to 900° F., in contact with particulate material of the character described below. The total pressure in the treating zone and the introduction of hydrogen and raw gasoline are controlled to provide a hydrogen partial pressure of preferably 100 to 250 psi. The total pressure of the system may vary over a relatively wide range, but it is generally preferred to use a total pressure not exceeding about 1000 psig.

Bauxite is a well known, native aluminum oxide in hydrated form, often containing iron. In commercial practice, the bauxite is ground to the desired particle size and dehydrated by heat treatment. The bauxite then being said to be "activated." This heat treatment is carried out at temperatures within a wide range, generally 600 to 1400° F. Activation of bauxite sometimes includes one or more additional processing steps like acid washing, and mechanical or magnetic separation of admixed minerals. While activated bauxite is a preferred contact material for the process of this patent, it is possible to charge ordinary bauxite into the reaction zone. At reaction temperatures of 900 to 1025° F., and at even higher regeneration temperatures, the bauxite will undergo dehydration and, thus, become activated.

The particulate contact material employed in the treating zone is an alumina of high surface area, viz., a surface area of preferably at least 125 sq. meters/gm., as measured by low-temperature nitrogen adsorption. The alumina of high surface area employed comprises bauxite, activated alumina, and similar preparations of high surface area derived from alumina gels.

Activated alumina is a commercial product well known in the petroleum treating art. Alumina gels prepared by precipitation of aluminum hydroxide from an aqueous solution of a soluble salt such as the nitrate, followed by filtration, washing, drying and calcining of the precipitate by conventional procedures, are also suitable contact materials for the process.

Although substantially pure hydrogen is advantageously used in the proc-




**HOW CATALYST POROSITY CAN BE IMPROVED.** Leaching alumina gel with acetylacetone will improve the surface porosity of metal oxide catalysts or adsorbents, according to U. S. Patent No. 2,693,457, Socony Mobil Oil Co. The above graph indicates the results obtainable by extraction of alumina gel pellets at 284° F., using an acetonyl acetone: alumina gel ratio of 1.5:1. About 27 wt.-% of material was removed by this treatment.

ess, a gas mixture containing hydrogen and inert gases, such as nitrogen or methane, may be employed with efficacy. In the latter case it is preferable to use a gas mixture having at least about 30% by volume of hydrogen in order to avoid the necessity of passing excessively large amounts of gas through the reaction zone to provide the desired hydrogen partial pressure of 50 to 325 psi. and in order to avoid the necessity of raising the total pressure of the system to a high value.

The following example, using a cracked raw gasoline from an East Texas residuum and derived by the above described process, indicates the results obtainable by Hydrocarbon's recently patented process.

| | Before Treatment | After Treatment |
|---|---|---|
| Octane number, CFRR clear (ASTM-D908-48T) | 90.8 | 91.3 |
| Bromine number cgs./gm. (ASTM-D875-46) | 60 | 78 |
| Olefin content, vol.-% | 41 | 53 |
| Copper dish gum, mg./100 ml. (ASTM-D910-48T) | 400 | — |
| Stability, minutes (ASTM-D525-49) | 145 | More than 1100 |
| Existent gum, mg./100 ml. (ASTM-D-381-49) | — | Less than 5 |

This raw gasoline is heated, by passing it through the coils of a tube still, to a temperature of about 700° F. The gasoline is then discharged into a reaction zone containing fluidized particles of activated bauxite. The gaseous treating atmosphere is provided and the fluidization of the bauxite particles is simultaneously effected by introducing a stream of hydrogen-containing gas into the bottom of the reaction zone. The gas contains 40 mol. percent hydrogen, the remainder being inert gas. A portion of the fluidized catalyst is continuously removed from the zone and passed to a regenerator, and a corresponding amount of regenerated catalyst is continuously returned to the reaction zone. In the reaction zone, the temperature is maintained at 890° F. and the total pressure is maintained at 400 psig. The heated raw gasoline is introduced into the reaction zone at a rate to provide a space velocity of 1.0 volume of liquid gasoline per hour per volume of catalyst in the reaction zone and the hydrogen is introduced at a rate to provide a hydrogen partial pressure of 152 psi.

The gasiform effluent is continuously removed from the top of the reaction zone, condensed, and then subjected to fractional distillation to separate from the gasoline more volatile hydrocarbons and gases, particles of the catalyst which may have been carried over with the effluent, and a small proportion of higher boiling hydrocarbons formed in the reaction zone.

The yield of gasoline is 94.1% by volume of charge, and the total yield of liquid products is 98.0% by volume of charge.

It will be seen from this example that, in accordance with the process, a cracked raw gasoline having a high content of gum forming constituents, as indicated by the 400 mgs. obtained in the copper dish gum test and the 145-min. break down in the stability test, is converted to a finished gasoline containing a substantial quantity of olefins, and having stability and gum-forming characteristics meeting commercial requirements. These significant improvements in the gasoline have been effected with an increase in octane number by one-half unit. The yield of this high quality finished gasoline is excellent.

### Patents Issued in August

*The following classified listing gives the patent number, patentee, or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazette of the U. S. Patent Office for August 2, 9, 16, and 23, 1955, Vol. 697, Nos. 1-4.*

## PROCESSES

### Refining

2,714,504 (Socony Mobil Oil Co., Inc.) Light weight fractionating tray.
2,714,578 (Texaco Development Corp.) Manufacture of permeable barriers for diffusive arylsilanol.
2,714,878 (Lev A. Makler) Petroleum heater.
2,714,940 (E. I. du Pont de Nemours & Co.) Purification of acetylenes from pyrolyzed gases by extraction with dimethylformamide.
2,715,018 (The Dorr Co.) Recovery of heat from finely-divided solids.
2,715,594 (The Standard Oil Co.—Ohio) Method of cleaning asphalt tanks, using hydrocarbon and steam.
2,715,606 (Universal Oil Products Co.) Solvent treatment of volatiles in the fractionation of normally solid materials.
2,715,948 (Esso Research & Engineering Co.) Direct contact condenser and absorber.
2,716,113 (Phillips Petroleum Co.) Separation process by urea adduct.
2,716,144 (Sun Oil Co.) Cyclic separation of aromatics from gasoline or kerosene fractions with silica gel.

### Conversions

2,715,048 (Houdry Process Corp.) Method and apparatus for elevating granular material.
2,715,565 (The Dorr Co.) Reactor furnaces for contacting finely divided solids with gases.
2,715,566 (Sun Oil Co.) Rotatable gas contacting apparatus (annular reaction vessel).
2,715,567-70 (Sun Oil Co.) Rotary catalytic converter sealing devices.
2,715,573 (The Institute of Gas Technology) Method for gasifying coal, using suspension.
2,715,601 (Phillips Petroleum Co.) Hydrogenolysis process utilizing suspended catalyst.
2,716,050 (Socony Mobil Oil Co., Inc.) Method of stopping the pneumatic transfer of granular material in a moving bed hydrocarbon conversion system.
2,716,054 (Socony Mobil Oil Co., Inc.) Kiln insulating lining for granular solid moving at high temperature.

### Hydrocarbon Synthesis

2,714,583 (E. I. du Pont de Nemours & Co.) Conversion of carbon monoxide and water to hydrocarbons in the presence of metal molybdite catalysts.
2,715,604 (Stanolind Oil and Gas Co.) Recovery of pure ethanol from hydrocarbon synthesis product.

## PRODUCTS

### Chemicals

2,714,604 (Celanese Corp. of America) Production of oxygenated hydrocarbons by vapor phase oxidation.
2,714,605 (Phillips Petroleum Co.) Sulfation of hydroxylated polybutadienes.
2,714,619 (Shell Development Co.) Process for polymerizing 1,3-dihaloolefins.
2,714,620 (Esso Research & Engineering Co.) Method of destroying sodium catalyst residues in the preparation of drying oils from copolymerized butadiene.
2,715,100 (Monsanto Chemical Co.) Acetylene solution in tetrahydrofuran.
2,715,561 (Florian F. Knotz) Method of preparing thiophosphoryl-chloride.
2,715,620 (California Research Corp.) Linear superpolyamides of 5-t-butyl-isophthalic acid.
2,715,647 (Phillips Petroleum Co.) Separation and purification of anthracene.
2,715,648 (Badische Anilin- & Soda-Fabrik Aktiengesellschaft) Process for the production of acetylene by incomplete combustion of hydrocarbons.
2,715,947 (Monsanto Chemical Co.) Chemical purification process for acetylenes, using oxygen-containing solvent.
2,716,120 (Phillips Petroleum Co.) Separation of alkenylpyridines from alkylpyridines.
2,716,128 (Universal Oil Products Co.) Condensation product of olefinic hydrocarbon with polysiloxane and method of production thereof.
2,716,136 (Esso Research & Engineering Co.) Purification of ethanolamines.

### Catalysts

2,716,091 (Socony Mobil Oil Co., Inc.) Regeneration of spent catalyst.

### Fuels

2,715,436 (Swingfire (Bahamas) Limited) Resonant pulse jet combustion heating device.
2,715,572 (United States of America as represented by the Secretary of the Army) Camphoric acid salts as inhibitors for water soluble fuels.
2,715,815 (Phillips Petroleum Co.) Flame resonance detector for jet engines.
2,715,832 (Phillips Petroleum Co.) Engine analyzer.
2,716,055 (Imperial Chemical Industries Ltd.) Production of water gas and the like.

### Lubricants

2,714,579 (Esso Research & Engineering Co.) Lubricating oil additives (aryl-silanol reaction product, etc.)
2,715,106 (The Pure Oil Co.) Lubricating oil composition containing sulfurized-phosphorized terpene alcohol and sulfonate.
2,715,107 (Shell Development Co.) Lubricating compositions containing perfluoro-organic compound.
2,715,108 (Shell Development Co.) Lubricating compositions containing carboxylic acid, oil soluble phenol and aromatic acidic compound as oxidation and corrosion inhibitors.
2,715,612 (Sinclair Refining Co.) Lubricating oil composition containing phosphorus sulfide hydrocarbon reaction product.
2,716,085 (The Pure Oil Co.) Adhesive petroleum lubricant containing unctuous, stringy non-crystalline wax tailings containing asphaltenes.
2,716,087 (California Research Corp.) Method of filtering dispersions of metal oxides and hydroxides in lubricating oils.
2,716,088 (Esso Research & Engineering Co.) Lubricating oil composition containing calcium sulfonate of white oil olefin.
2,716,089 (Esso Research & Engineering Co.) Motor oil inhibitor to suppress coking (Sb salt of dihydrocarbon dithiocarbamic acid).
2,716,090 (Esso Research & Engineering Co.) Plasticizing agent for mineral oil solutions of metal salt of phenol sulfide.

### Specialties

2,714,568 (Esso Research & Engineering Co.) Asphalt laminate.
2,715,072 (Universal Oil Products Co.) Retarding

skinning of drying oil composition with alkyl-alkoxyphenol.
2,715,073 (Universal Oil Products Co.) Stabilization of waxes with alkyl-alkoxy phenol, citric acid and metal deactivator.
2,715,605 (Jefferson Chemical Co., Inc.) Prevention of corrosion of ferrous metals by alkanolamines and antimony oxide.
2,716,053 (Phillips Petroleum Co.) Carbon black production from CO.
2,716,073 (Nopco Chemical Co.) Heat-treated magnesium soap-wax composition.

### Miscellaneous

2,714,200 (Humble Pipe Line Co.) Control device for internal combustion engines.
2,714,853 (Shell Development Co.) Pump for delivering small discrete quantities of liquid.
2,715,610 (The Standard Oil Co.—Ohio) Proportioner for chemical feed.
2,715,711 (Allen Electric Equipment Co.) Method and means for checking ignition timing of an internal combustion engine.
2,716,057 (Ethyl Corp.) Metal powders.

## EQUIPMENT

### Instruments

2,714,310 (General Electric Co.) Mass rate flowmeter.
2,714,547 (The Atlantic Refining Co.) Flowmeter recorder.
2,714,715 (Charles A. Manier) Oil level indicator.
2,714,819 (Abraham Donsky, Henry Nauberett, Morris Paulovich) Dew point indicator.
2,714,868 (The Imperial Brass Mfg. Co.) Flow indicator.
2,714,869 (Erwin F. Eimer) Bulk tank level gauge.
2,714,894 (Leeds & Northrup Co.) Apparatus for transfer from auxiliary to automatic control in pressure-actuated systems.
2,714,994 (John J. McGillis and Hugh D. McGillis) Temperature control apparatus having a plurality of thermal responsive devices.
2,715,831 (D. Napier & Son Ltd., London, England) Apparatus for sensing changes in the specific gravity of a liquid.
2,715,833 (National Institute of Cleaning & Dyeing) Apparatus for measuring the relative humidity within an aqueous liquid.
2,715,836 (Harrison D. Brailsford) Apparatus for determination of relative humidity.
2,716,169 (Raymond Alvah Hanson) Level sensitive switch.

### Processing, general

2,714,224 (Ruhrchemie Aktiengesellschaft, Oberhausen-Holten, Germany) Apparatus for granulating chemical substances.
2,714,453 (Secretary of the Army for the U. S. of America) Apparatus for fractionating finely divided material.
2,714,458 (Crofts Ltd., Thornbury, Bradford, England) Devices for feeding granular and other similar materials.
2,714,504 (Socony Mobil Oil Co., Inc.) Light weight fractionating tray.
2,714,552 (Surface Combustion Corp.) Direct condensate cooler in flue gas generator.
2,714,877 (Babcock & Wilcox Co.) High pressure primary air heater.
2,714,878 (Lev. A. Mekler) Petroleum heater.
2,714,918 (Courtaulds Ltd., London, England) Apparatus for the de-aeration of viscous liquids.
2,714,964 (Paul S. Radford) Liquid filter.
2,715,019 (Combustion Engineering, Inc.) Means for temperature equalization in heat exchanger.
2,715,048 (Houdry Process Corp.) Apparatus and method for elevating granular material.
2,715,098 (Automatic Pump & Softener Corp.) Base exchange water treatment apparatus.
2,715,373 (Coleman Co., Inc.) Baffle tube for combustion chamber.
2,715,516 (Standard Oil Co.-Indiana) Heat exchanger design.
2,715,517 (Gustav Bojner, Stockholm, Sweden) Rotary, tubular heat exchanger.
2,715,565 (The Dorr Co.) Reactor furnaces.
2,715,566 (Sun Oil Co.) Rotatable gas contacting apparatus.
2,715,567 (Sun Oil Co.) Rotary converter sealing devices.

Years of dependable service in leading steel mills, chemical plants, etc. A type for every acid proofing use.
Trial Order 10 lb. lot $3.30
Sauereisen Cements Company · Pittsburgh 15, Pa.

*Here's how it pays off in sulfur recovery*

By reporting around-the-clock on the concentration of $H_2S$ and $SO_2$ in sulfur-extraction plant tail gas, CEC's Type 21-610 Mass Spectrometers pay off in two important ways. By means of its continuous, accurate monitoring, the ratio of the two gases in the stream can be controlled within critical limits, which increases the profitable elemental sulfur output by as much as *1½ tons per day* in a typical plant. And, important to community relations, air pollutants are reduced to an absolute minimum, for when the ratio is just right, the release of harmful, irritating sulfur compounds to the atmosphere is practically eliminated.

**Now . . . two process-monitoring mass spectrometers**

*For monitoring and controlling streams to mass 80*

**TYPE 21-610** is moderately priced and a truly general-purpose instrument. Although primarily designed for continuous petroleum and petrochemical stream analysis, it is also valuable for production-line leak detection or laboratory analysis. Its applications have ranged from on-the-spot acetylene-plant monitoring to hospital clinical tests on lungs.

*For higher resolving power and readings to mass 150*

**TYPE 21-620** has the highest mass range of any instrument in its compact size range. Using the new "Cycloidal Focusing" principle, it goes beyond the 21-610 for accurate readings from mass 2 to mass 150. Medical laboratories, petrochemical plants and general research organizations will all find it ideal for their analytical problems.

*Send for Bulletin CEC 1824A-X25.*

**Consolidated Engineering**
*Corporation*

ELECTRONIC INSTRUMENTS FOR MEASUREMENT AND CONTROL

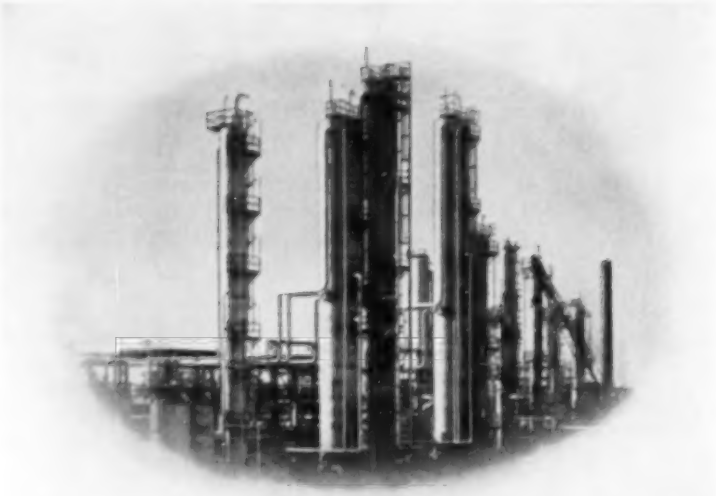
300 North Sierra Madre Villa, Pasadena 15, California

*Sales and Service Offices Located in: Albuquerque, Atlanta, Buffalo, Chicago, Dallas, Detroit, New York, Pasadena, Philadelphia, San Francisco, Seattle, Washington, D. C.*




*(To obtain more data on advertised products see page 1628)*

# FROM YOUR BASIC FLOW DIAGRAMS— A FINISHED PLANT QUICKLY, ECONOMICALLY



A plant designed for *your* needs based on *your* process flow diagrams—this is the service we offer petroleum refiners. Each Kuljian project is unique because it is designed . . . and built . . . with just one objective in mind—the maximum return on your investment at the earliest possible date.

## ENGINEERING OR CONSTRUCTION
## ENGINEERING AND CONSTRUCTION

**Kuljian Experience Includes:**

*Refinery Facilities In General*
*Process Systems & Instrumentation*
*Fuel Storage Systems & Piping*
*Steam Generation & Utilization*
*Electrical Generation & Distribution*

The Kuljian Corporation
engineers • constructors
1200 North Broad Street • Philadelphia 21, Penna.

BRANCH OFFICES THROUGHOUT THE WORLD


## Patents

2,715,568 (Sun Oil Co.) Rotary converter sealing devices.
2,715,569 (Sun Oil Co.) Rotary converter sealing devices.
2,715,570 (Sun Oil Co.) Rotary converter sealing devices.
2,715,607 (Lee Foundation for Nutritional Research) Knockdown distillation apparatus.
2,715,609 (Thorwald H. Hansen) Valved aeration device.
2,715,835 (Bacock & Wilcox Co.) Vapor generating installation having a liquid level indicator with an auxiliary liquid chamber.
2,715,945 (Paul M. Hankison and Donald K. Bice) Method and apparatus for removing foreign materials from gaseous fluids.
2,715,948 (Esso Research & Engineering Co.) Direct contact condenser and absorber.
2,715,964 (Warren S. Martin) Granular bed filter.
2,715,965 (Fred S. Carver, Inc.) Pressure filter.
2,716,024 (Celanese Corp. of America) Apparatus for the treatment of oxygenated compounds.
2,716,042 (Pittsburgh Consolidation Coal Co.) Solids feeding device.
2,716,054 (Socony Mobil Oil Co., Inc.) Kiln insulating lining.
2,716,141 (William T. Miller) Preparation of halo aliphatic compounds.

### Pumps & Compressors

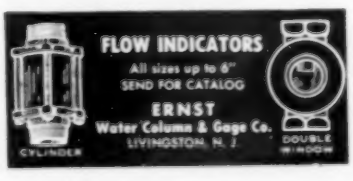
2,714,354 (Orrin E. Farrand) Centrifugal Pump.
2,714,484 (National Research Corp.) High-vacuum pump.
2,714,851 (Shell Development Co.) Reciprocating pump for delivering small discrete quantities of liquid.
2,714,856 (The Commercial Shearing & Stamping Co.) Rotary pump or motor.
2,714,857 (Geo. D. Roper Corp.) Gear pump.
2,714,858 (Frank Kepka and Jean A. H. Barkell) Rotary compressors or pumps, in combination with hydraulic controls, and mechanical controls in co-ordination therewith.
2,714,963 (Herbert C. Lester and Alfred H. McKinney) Injection pump.
2,715,190 (Allis-Chalmers Mfg. Co.) Dual flow direct current linear electromagnetic pump.
2,715,494 (Secretary of the Air Force for the U. S. of America) Rotor for axial flow air compressor.
2,715,610 (Standard Oil Co.—Ohio) Proportioner for chemical feed.
2,715,993 (W. M. Welch Mfg. Co.) Ionization pump.

### Valves & Fittings

2,714,192 (Jean Mercier) Valves.
2,714,394 (Alco Valve Co.) Four-way changeover valve.
2,714,685 (Detroit Controls Corp.) Mixing valve.
2,714,497 (Grinnell Corp.) Pipe hanger.
2,714,882 (Procter Brevard) Seal for a slide valve.
2,714,896 (Combustion Engineering, Inc.) Multiple safety valve arrangement.
2,714,897 (Automatic Pump & Softener Corp.) Multiple flow control valve.
2,715,010 (Donald H. Reeves) Fluid valve assembly.
2,715,412 (W-K-M Mfg. Co., Inc.) Gasketed valve.
2,715,415 (Leslie W. Nuckolls and Roderick Nuckolls) High pressure float valve.
2,715,416 (Edwin W. McKinley) Fluid pressure valve regulator.
2,715,417 (Wallace & Tiernan Inc.) Pneumatically operated gas flow control apparatus.
2,715,818 (Cameron Iron Works, Inc.) Plug valve.
2,715,910 (Samuel M. Kass) Float control valve.
2,715,913 (John L. Taylor) Control valve.
2,716,015 (Stewart-Warner Corp.) Snap acting thermostatic valve.
2,716,016 (Cameron Iron Works, Inc.) Plug valve.
2,716,017 (Grinnell Corp.) Diaphragm valves.

### Miscellaneous

2,714,574 (Detrex Corp.) Degreasing and cleaning apparatus.
2,714,900 (Ellis H. Williams) Pipe thread protector.
2,715,419 (Superior Pipe Specialties Co.) Accumulator.
2,715,719 (International Telephone & Telegraph) Remote supervisory and control system.
2,715,909 (Sellers Injector Corp.) Storage tank vent valve.
2,715,914 (Robert E. Roberts) Flexible tube.

### Borg-Warner Buys B-J

Effective September 1, Byron Jackson Co., a pioneer west coast manufacturer of oil equipment, will become a division of Borg-Warner Corp. The merger was approved by Byron Jackson stockholders at a special meeting, at which president E. S. Dulin stated that Jackson Co. would retain its own identity, management and operating policies. Borg-Warner is known as a leading manufacturer of automotive, aircraft and agricultural equipment.

### ACF Merges with Key Co.

Another recent merger was the acquisition of all property and assets of Key Co., East St. Louis, Illinois, by the ACF Industries, Inc. Key Co. is known in the oil industry as a manufacturer of high pressure and temperature fittings.

**CONSTRUCTION HAS BEEN STARTED** on the new $6 million synthetic fluid petroleum cracking catalyst plant at Valleyfield, near Montreal, of Davison Chemical Co., Ltd. This Canadian firm was formed by Davison Chemical Co. Division of W. R. Grace & Co. Architect-engineers for the new project are Badger Division of Stone & Webster Engineering Corp. Davison's project manager is W. E. MacLean

### Fluor Combines Operations

In a major organizational change, the Fluor Corporation, Ltd., is combining their engineering and construction operations into one division. M. A. Ellsworth, who has served as vice-president in charge of sales since 1952, will head the new division as vice-president and general manager. Ellsworth joined Fluor's sales staff at Tulsa, Okla., in 1940 and was named Tulsa district manager 4 years later. Reporting to Ellsworth will be J. G. Marshall, vice-president, general engineering; Ernest Moncrief, vice-president, Mid-Continent division; Lee Van Horn, vice-president, process engineering and development; W. P. Downey, vice-president, construction; and J. P. Kneubuhl, vice-president, engineering and construction sales.

Mr. Ellsworth

### Consolidated Keeps Moving

Formed 18 months ago, the Systems Division of Consolidated Engineering Corp. recently moved into larger headquarters in Pasadena. The division which engineers, builds, installs and services automatic data-processing and industrial control systems has leased 4,200 square feet of a new $75,000 building near the company's main plant for engineering and administrative operations.

Electrodata Corp., an affiliate of Consolidated, and manufacturer of electronic computers, has completed moving its manufacturing equipment and personnel of 300 into its new 40,000 square foot plant near Pasadena. Located just north of its parent affiliate, the new $525,000 building brings together operations previously occupying four separate locations.

New members of Consolidated's board of directors are Hugh F. Colvin, vice president and general manager; Victor J. Pollock, treasurer and secretary.

Recent promotions within Consolidated are: Albert W. Brandmaier, Linden G. Criddle, and Jack K. Walker from senior engineers to principal engineers; John D. Gum, Glyn A. Neff, and William D. Schultz from engineers to senior engineers; and Edward Jacobs and Harold R. Kramer to assistant engineers.

### CF&I Completes Installation

Colorado Fuel and Iron Corp. has completed installation of a 3000 ton "push-through" press at it's Wickwire Spencer Steel plant in Claymont, Delaware. The press, capable of exerting a maximum force of six million pounds, will be used to produce heads up to 10 feet in diameter, as well as motor ends, contour plates, channels and corrugated shapes.

### Houston Plant for Farris

Farris Engineering Corp. has established a new plant in Houston, Texas, for the manufacturing and servicing of the company's valves, governors and other products. Manager of the new plant is Edward Groth. Other new staff appointments within the Farris Affiliated Cos. include Charles W. Hanlon as sales manager of the Farris Flexible Valve Corp., and new area managers: Charles S. Lewis, midwest; Albert F. Stumm, mid-Atlantic; and Edward Groth, southwest.

### Larson with Oxy-Catalyst

Gordon P. Larson, former smog control director of Los Angeles, has been appointed vice president of Oxy-Catalyst, Inc. of Wayne, Pa. This firm, headed by president Eugene J. Houdry, is developing and producing catalytic oxidizing equipment for all types of exhaust systems. Larson, a graduate of West Point, served for 12 years in the Corps of Engineers. The last six years he has served as director of the large research program sponsored by Los Angeles County to combat air pollution in that region.

Mr. Larson

### Kodak Licenses Consolidated

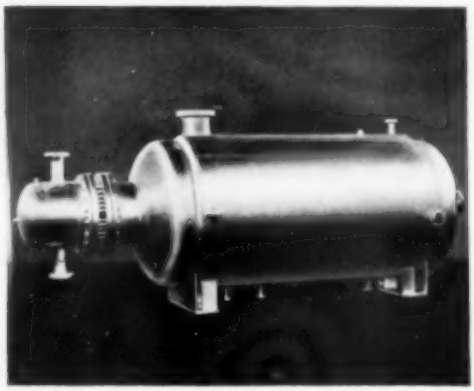
Eastman Kodak and Consolidated Vacuum Corp., the high-vacuum subsidiary of Consolidated Engineering Corp., have concluded a licensing agreement allowing Consolidated Vacuum to manufacture and market certain apparatus developed by Distillation Products Industries division of

**ECONOMY**
High-alloy layer—usually 10% or 20% of total plate thickness—assures corrosion and abrasion resistance, long equipment life.

**DESIGN FREEDOM**
Integral bond allows design and fabrication of shapes to meet process and space needs.

**STRUCTURAL STABILITY**
Low-cost carbon steel backing provides necessary strength and rigidity.

*Nickel-clad steel gives this jacketed heating unit high corrosion resistance in processing light hydrocarbons and dilute hydrochloric acid.*



## CLAD STEEL EQUIPMENT PERMITS

# FULL DESIGN FREEDOM

When new equipment is being planned, economical clad steels will assure maximum design freedom for your tanks and pressure vessels. Because of the integral bond between high-alloy cladding and the carbon steel backing plate, full gage consideration is permissible under the API-ASME Code. Clad can be readily worked by conventional fabricating tools and methods, permits easy and economical field erection. In service, clad steel helps protect against unscheduled shut downs stemming from seepage or crevice corrosion.

Clad steels offer you all the corrosion resistance of solid, high-alloy construction with savings up to 50% in material costs. These and other benefits, easy cleaning, drainage inspection or modification, can be obtained from 16 cladding materials—various types of stainless, nickel, Inconel, Monel, copper.

These are supplied with a standard sodium hydride finish, or may be polished to help improve performance characteristics. When you're thinking of new tanks and vessels, qualified equipment builders can help your engineers and consultants take advantage of versatile Lukens' Clad Steels. We work closely with fabricators to help select the type most suited to your processing needs. To get more information, ask one of your equipment builders, or write Manager, Marketing Service, Lukens Steel Company, 752 Lukens Building, Coatesville, Pennsylvania.

**LUKENS CLAD STEELS**

**STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD**

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEEL PLATES AND HEADS AVAILABLE

Kodak. Under the arrangement, manufacture of centrifugal stills and "brush-type" stills used in the petroleum, chemical and pharmaceutical industries will be undertaken by Consolidated Vacuum.

### Personnel Changes

**Orbit Valve Co.**—L. E. Wallace to sales manager and Ralph H. Soape to district manager at Houston, Texas.

**Hammel-Dahl Co.**—John R. Curran elected to vice president from his previous post as engineering director.

**Hammond Iron Works**—Fred J. Myers to district sales manager with headquarters at Warren, Pa.

**Cochrane Corp.**—M. C. McKeown to manager of Philadelphia sales office of his company, producing water conditioning equipment. He is the author of numerous papers on water conditioning.

**The Trane Co.**—Joseph Wait appointed to the Washington, D. C., sales office.

**General Electric Co.**—C. S. Wiedman to manager of carbide products development engineering for the Carboloy Department.

**Fritz W. Glitsch & Sons, Inc.**—Robert L. Allen appointed general sales manager of this firm producing bubble trays and other refining items.

**Vitro Corp. of America**—Thomas R. Darmody to assistant general manager of Vitro Engineering Division.

**Byron Jackson Co.**—W. E. Jensen to assistant chief engineer, located in company's main offices in Los Angeles.

**Acheson Colloids Co.**—Raymond F. Stevens has joined company as a research chemist and will supervise the research program under the direction of Dr. Harold J. Dawe.

**Frontier Chemical Co.**—John B. Childress to sales representative to the oil industry and other users of basic chemicals in the Texas area.

**Oakite Products, Inc.** — John A. Price, John C. Mullarkey and Charles L. Blasingame appointed new technical service representatives.

**The Foxboro Co.**—R. E. Rogers to manager of West Coast sales activities; E. W. Pitt to Los Angeles branch


# Want to improve gasoline quality and reduce treating costs?

## Send for this NEW BULLETIN NOW!

This new technical bulletin on **dbpc®** antioxidant (2,6 di-tertiary-butyl-para-cresol) was developed to help the refiner understand more fully the many factors which influence gasoline gum formation and automotive induction system deposits. Much of the data is dramatically revealed through newly designed laboratory equipment which is described in detail. And a new inhibiting practice is outlined for the refiner who wishes to improve gasoline quality while reducing treating costs.

Interesting charts, tables, and effectiveness graphs on **dbpc** antioxidant in use and in storage are contained in the bulletin. Furthermore, actual comparisons are made with different types of inhibitors to prove the efficiency and economy of **dbpc** antioxidant.

• • •

Send for your free copy of this factual, informative bulletin, today. Find out how **you** can make a better gasoline at less cost. Write to:

**KOPPERS COMPANY, INC.**
**Chemical Division, Dept. PP-105, Pittsburgh 19, Pennsylvania**

KOPPERS ®

**Koppers Chemicals**

SALES OFFICES: NEW YORK • BOSTON • PHILADELPHIA • ATLANTA
CHICAGO • DETROIT • HOUSTON • LOS ANGELES


 *(To obtain more data on advertised products see page 1628)* 

# CLASSIFIED

**THE DOW CHEMICAL COMPANY**
**TEXAS DIVISION**
**FREEPORT, TEXAS**

*Offers Opportunities for:*

**ORGANIC CHEMISTS**
**ANALYTICAL CHEMISTS**
**POLYMER CHEMISTS**
**PHYSICAL CHEMISTS**
**CHEMICAL ENGINEERS**
**MECHANICAL ENGINEERS**

with

**B.S., M.S., Ph.D. Degrees**

**0 to 5 Years Experience**

Positions available for qualified candidates in Organic and Inorganic Research, Development, Organic and Inorganic Production, Process and Plant Design, an Analysis.

**Moving Expenses Paid**
**Good Housing Conditions**

Qualified applicants please submit resume and record of college work to:

**D. M. Duguid**
**The Dow Chemical Co.**
**Freeport, Texas**

**STEEL PIPE & TUBING**
• CHROME MOLY • CARBON MOLY
• MONEL • CARBON STEEL • STAINLESS
Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST
Send us your Surplus Lists
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. OA 8-4030


manager; D. P. Thomas to branch manager at Shreveport, La.; M. F. Parr to regional engineer at San Leandro; C. E. Heegard to industrial engineer at Los Angeles; and C. J. DeVilbiss transferred from Dallas to industrial engineer at Shreveport.

**Norton Co.**—Gale W. Bennett appointed a refractories engineer, succeeding Norman K. Russell who resigned from Norton to become sales manager for Richmard C. Remney & Sons Co. of Philadelphia.

**Babcock & Wilcox**—Carl Claus named director of staff, coordinating various staff functions of several departments and personnel. J. E. Brinckerhoff assumes full management of the refractories division upon the retirement of A. M. Kohler, former vice president and head of the division.

**Tube Turns**—W. C. Robinson to assistant sales manager of this division of National Cylinder Gas Co.

**The Perkin-Elmer Corp.** — Paul Hutchinson appointed sales manager of the laboratory instruments division at Norwalk, Conn.

**Tube-Kote, Inc.**—Ted Sandelius appointed sales engineer to direct the newly expanded customs coating department.

**Kaiser Steel Corp.**—John A. Shackleton named manager of pressure vessel engineering for Napa, California plant. He comes from the Union Oil Co.'s Oleum refinery where he was project engineer and manager.

**Witco Chemical Co.**—William Blalock to technical representative for stearates, operating in Witco's west coast region.

**Cooper-Bessemer Corp.** — S. N. Campbell assigned to the Houston, Texas, office handling engineering and sales of company's products. W. H. Kraemer to the company's branch office in Los Angeles.

**Foster Wheeler Corp.** — Bernard F. Gilligan to sales manager, process plants division, gulf coast division; Wilson Pais to sales manager for equipment division in the same area.

**Stanford Research Institute** — George A. Agoston has joined the physical sciences division as senior physicist; was formerly research director for Kerr-McGee Oil Industries and senior research engineer with California Institute of Technology.

### *Expansion, Transition*

**Leader Iron Works,** Decatur, Ill., fabricator of custom built process equipment, has created a new coatings division headed by W. W. Wibel. This new division will handle the sale of protective coatings as well as the application of these coatings to tank and hopper cars, tank trucks, and process equipment.

**Union Carbide and Carbon Corp.** are planning to build a new home office building in New York City, between Park and Madison, and 47th and 48th Streets. The proposed 41-story building will cost an anticipated 40 million dollars; completion for occupancy by all the corporations nine divisions and subsidiaries is scheduled for 1958. Architects are Skidmore, Owings & Merrill.

**Crane Packing Co.'s** new plant at Morton Grove, suburb of Chicago, is being enlarged by the addition of two new buildings to house research and laboratory operations, as well as the office and cafeteria. Already on the site is the 126,000 sq. ft. factory building producing mechanical seals and packings, products made of DuPont Teflon, and lapping machines and pipe joint and thread compounds.

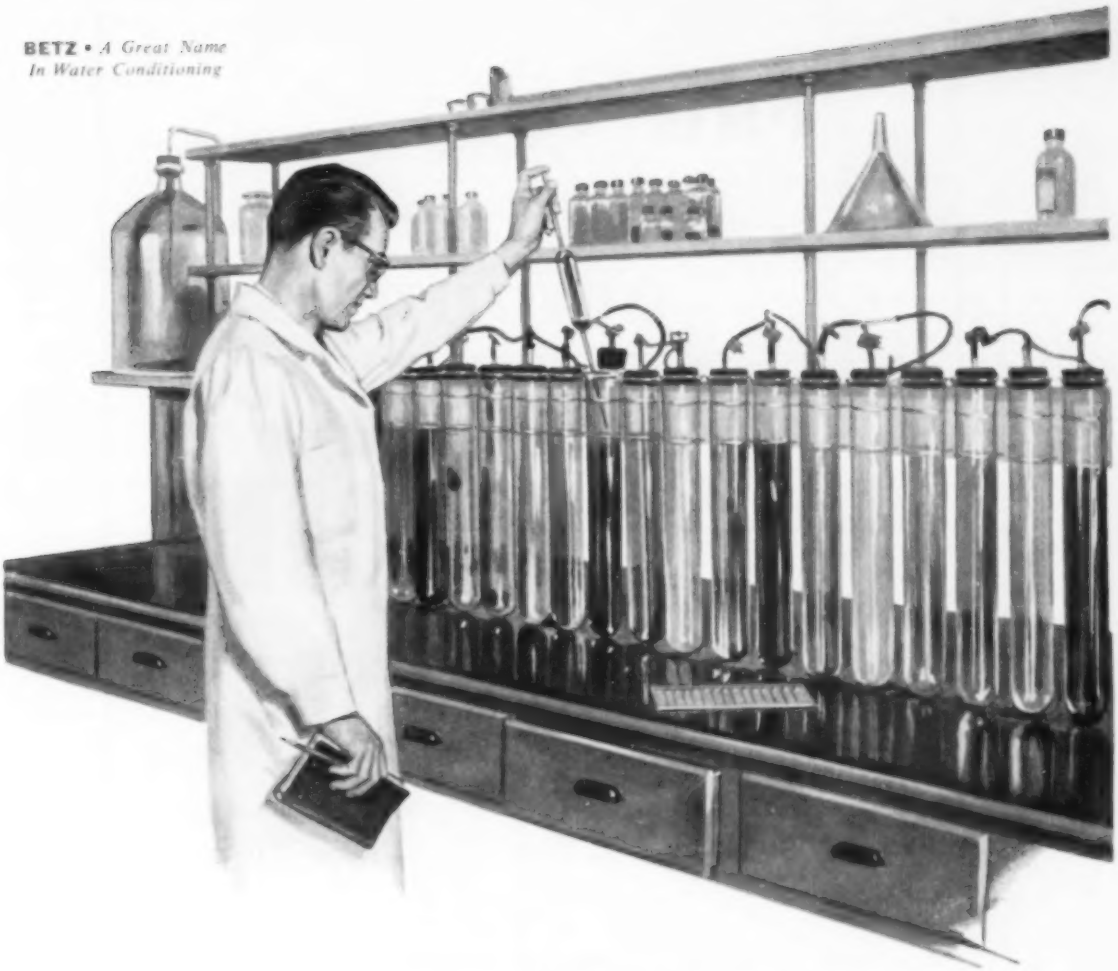
**Tube Reducing Corp.** has completed conversion of 100,000 sq. ft. of their Wallington, N. J., plant for the production of a new type of cold finished tubing known as "Rockdrawn." The process, combining cold compression rolling and cold drawing, will be capable of producing several million feet of the new tubing per month.

**Vanton Pump & Equipment Corp.** has appointed Unit Process Company of Seattle, Washington, as sales representative for the Northwest and Alaska.

**Research-Cottrell, Inc.,** of Bound Brook, N. J., manufacturers of Cottrell electrical precipitators, has announced the appointment of two new sales representatives. In Canada they will be represented by Sheldons Engineering Limited, Galt, Ontario; in Mexico, by Equipos de Proceso, S. A., Edificio Internacional, Reforma 1-556, Mexico 1, D. F.

**The Fielden Instrument Division,** Robertshaw-Fulton Controls Co. has opened a western regional sales office in Lynwood, California. Charles J. O'Lone will supervise the office, providing engineering assistance on industrial instrumentation techniques.

**BETZ** • *A Great Name*
*In Water Conditioning*



# He's researching another first!

Big things are happening daily in industrial water conditioning . . . new developments . . . new discoveries . . . new techniques. As the leader in researching better ways to condition water, Betz is far out in front. The record speaks for itself. For example, Betz was

. . . *first* to develop an advanced method for the *complete* control of corrosion in condensate lines.

. . . *first* to develop an economical technique for the control of corrosion and pitting in recirculating cooling water systems.

. . . *first* to pioneer the use of effective antifoam agents for prevention of carryover.

. . . *first* to develop a practical method of silica removal from boiler feedwater.

These Betz firsts are *just a few* of the many industry-accepted water conditioning methods that have resulted from our *continuing* program of research. Many more are to follow.

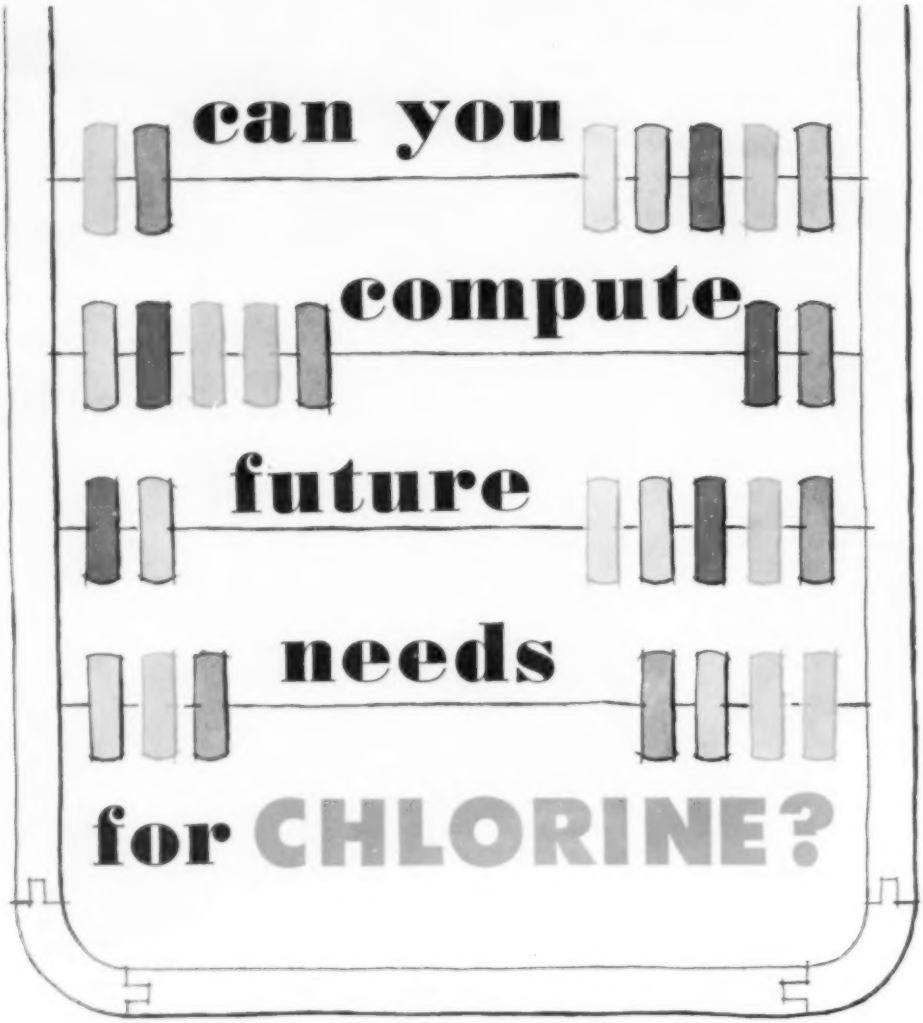
Isn't this the kind of leadership and ability *you* want in water conditioning counsel for *your* plant? A Betz District Engineer will be happy to give you the details of Betz complete plant service. Talk to him today.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.

In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS




If you're buying chemicals today, chances are you'll be buying even greater tonnages five years from now. Will other companies also have larger needs? Will there be new users?

*Coordinated planning and production* with Olin Mathieson assures the availability of chemical raw materials regardless of changing market conditions; assures adequate chemical production to supply growing industrial capacity; speeds the development of new chemical products and processes; provides greater flexibility in shipping and handling of materials; provides the personal attention of recognized product experts backed by widely diversified research facilities.

Today, more than ever, an association with an alert, aggressive chemical producer is essential to your future. Olin Mathieson's long experience and familiarity with the broad market picture will prove invaluable in your planning. Why not consult with us *now*?

3301-ACL

MATHIESON

MATHIESON CHEMICALS
OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION · BALTIMORE 3, MD.

**INORGANIC CHEMICALS:** Ammonia · Bicarbonate of Soda · Carbon Dioxide · Caustic Soda · Chlorine · Hydrazine and Derivatives · Soda Ash
Hypochlorite Products · Nitrate of Soda · Nitric Acid · Sodium Chlorite Products · Sulphate of Alumina · Sulphur (Processed) · Sulphuric Acid

**ORGANIC CHEMICALS:** Ethylene Oxide · Ethylene Glycols · Polyethylene Glycols · Glycol Ether Solvents · Ethylene Dichloride · Dichloroethylether
Formaldehyde · Methanol · Sodium Methylate · Hexamine · Ethylene Diamine · Polyamines · Ethanolamines · Trichlorophenol · Trichlorobenzene

# Two SAE Meetings in November

THE Society of Automotive Engineers will sponsor its annual fuels and lubrication and diesel engine meetings during the month of November. The first event is to be held at the Hotel Bellevue Stratford, Philadelphia, from Nov. 9 to 10. The meeting on diesel engines is scheduled for Nov. 2 to 4 at the Chase Hotel in St. Louis, Mo.

On the fuels and lube program will be the following papers:

"Nitrogen Oxide Combustion and Engine Deposition," by R. S. Spindt, C. R. Wolfe, and D. R. Stevens, Gulf Research & Development Co.

"Mechanism of Engine Sludge Formation and Additives Action," by D. T. Rogers, W. W. Rice, and F. L. Jonach, Esso Research and Engineering Co.

"Stop Sludge and Go Clean," by R. H. Albrecht, and R. I. Potter, Standard Oil Co. (Ohio), and Ken Hyatt, du Pont Co.

"CLR Oil Test Engine (Progress Report of the CRC-ELD Oil Test Engine Group of the Coordinating Research Council)," by W. G. Ainsley, Sinclair Research Laboratories, and A. E. Cleveland, Ford Motor Co.

"Road Vapor-Lock Incidence," by H. I. Wilson, R. S. Fein, J. R. Munger, and R. S. Wetmiller, The Texas Co.

"A Recent Look at Some Problems Related to Gasoline Volatility (Progress Report of the Activities of the CFR-MFD Volatility Group of the Coordinating Research Council)," by W. P. Dugan, Sun Oil Co., F. T. Finnigan, Pure Oil Co., J. G. Moxey, Jr., Sun Oil Co., and Gilbert Way, Ethyl Corp.

"Future Gasolines for Future Engines," by P. C. White, and A. P. Boyd, American Oil Co., and J. D. Domke, Standard Oil Co. (Ind.).

"The Knocking Behavior of Fuels and Engines," by R. V. Kerley and K. W. Thurston, Ethyl Corp.

"Road Rating with Chassis Dynamometer," by P. E. Mizelle, J. C. Porter, and A. R. Rescorla, Cities Service Research & Development.

"Problems of Fuel Injection for Gasoline Automotive Engines," by F. C. Mock and W. C. Suttle, Bendix Aviation Corp.

"Automotive Gasoline Injection," by S. E. Miller, American Bosch Arma Corp.

Papers of special interest to petroleum refiners at the diesel engine meeting follow:

"The CRC Smokemeter—Interim Report on a Continuous Filtering-type Smokemeter for Automotive Use," by H. C. Hunter, Coordinating Research Council, CFR Diesel Fuels Division.

"Factors Affecting Diesel Smoke in Highway Operation," by W. A. Howe, Gulf Oil Corp.

"The Napier 'Deltic' Diesel Engine," by Ernest Chatterton, D. Napier & Son.

"Physical and Chemical Ignition Delay in an Operating Diesel Engine Using the Hot-Motored Technique," by T. C. Yu, University of Wisconsin; R. N. Collins, Continental Oil Co.; K. Mahadevan, Indian Institute of Science; O. A. Uyehara and P. S. Myers, University of Wisconsin.

"Fuel Heat Gain and Release in Bomb Autoignition," by R. H. Hurn, J. O. Chase, C. F. Ellis, and K. J. Hughes, U. S. Bureau of Mines.

"Fuel Vaporization and Ignition Lag in Diesel Combustion," by M. M. El Wakil, P. S. Myers, and O. A. Uyehara, University of Wisconsin.

## Two Symposiums Slated for AIChE S. Texas Meeting

Symposiums on air and stream pollution and operations research will highlight the 10th annual technical meeting of the South Texas Section of the American Institute of Chemical Engineers. The meeting will be held at the Hotel Galvez in Galveston, Texas, on Oct. 14 and will include a social program and the usual technical sessions.

The morning technical sessions will run concurrently with the air and stream pollution symposium. Among the papers of the former are:

"Fuel Requirements of Tomorrow's Engines," by D. R. Diggs, du Pont Co.

"Using the Epoxy Resin," by C. V. Wittenwyler, Shell Chemical Co.

The symposium will include these papers:

"Climate, Air Pollution and Plant Design," by W. A. Quebedeaux, Jr., Harris County Health Unit, Houston.

"Subsurface Disposal of Chemical Wastes at Victoria, Texas, Plant of the du Pont Co.," by H. O. Henkel, du Pont Co.

"Use Without Abuse of Our Natural Waters," by Ruth Patrick, Academy of Natural Sciences of Philadelphia.

"Sulfur Dioxide Pollution of Air," by Moyer D. Thomas, Stanford Research Institute.

In the afternoon, the symposium on operations research will have the following papers:

"Operations Research Introduction," by John F. Magee, Arthur D. Little.

"Organizing for Operations Research," by Walter M. Carlson, du Pont Co.

"Operations Research Activities at Humble," by J. P. Hamilton, Humble Oil and Refining Co.

"Automation," by Albert Sperry, Panellit Corp.

The final technical session will be concerned with the prospects of student chemical engineers. It will be held concurrently with the operations research symposium.

### How to Find Friends At API Meeting

If you want to look up friends or make business contacts while you are at the API convention in San Francisco, McGraw-Hill's petroleum publications have made it easier for you. Here are two ways you can go about it:

- Use the direct-wire phones that will be installed near the API registration booths at each of the convention hotels—Mark Hopkins, Fairmont, St. Francis, and Sheraton Palace. These phones will connect you, without your dialing, with our central information office, where special operators will tell you the hotel and room number of anyone who registers for the convention.
- Dial the following number on any public phone and you will receive the same service:

GARFIELD 1-5841

## Doolittle to Address Refiners at API Meeting

The American Petroleum Institute's annual meeting will be held this year in San Francisco from Nov. 14 to 17. Headquarters will be at the Mark Hopkins, Fairmont, St. Francis, and Palace Hotels.

The division of Refining plans one session during the meeting. This is to take place on Monday afternoon, Nov. 14, and two speakers have been announced. They are Jimmy Doolittle, vice-president of Shell Oil Co., and Dr. Wallace Sterling, president of Stanford University.

## NACE Groups Schedule Two Regional Meetings

Two regional meetings will be offered by divisions of the National Association of Corrosion Engineers in October and November. The first of these is the Oct. 18-21 meeting of the South Central Regional Division at the Shamrock-Hilton Hotel, Houston, Texas.

The technical program will feature two symposiums on recirculated water, a symposium and round table discussion on cathodic protection, and symposiums on pipe lines, high temperature corrosion, the oil and gas industries, protective coatings, corrosion and inhibitors, utilities, chemical processing industries, and marine corrosion.

Corrosion problems in the process industries will be examined in the second meeting, a short course to be given jointly by the Western Regional Division and the University of Cali-

fornia Nov. 14-17 at the University Extension Building in San Francisco.

The following topics will be taken up: equipment inspection in process plants, corrosion testing in process plants, handling of sulfuric acid, handling caustic, furnace stack corrosion, high-temperature problems in process plants, special metallurgical problems, metallic and non-metallic linings for corrosion protection, cooling water problems, and cathodic protection in the process industries.

## SNT to Meet During 37th Metal Congress

The annual National Metal Congress and Exposition, now in its 37th year, will be held in Philadelphia from Oct. 17-21. The congress sessions will be held in the hotels where the sponsoring societies are to make their headquarters. The exposition will be set up in the city's convention hall.

Besides the American Society for Metals, chief sponsor of the show, there are these cosponsors: the Society for Non-Destructive Testing, American Welding Society, and the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers.

The Society for Non-Destructive Testing will hold its sessions at the Sylvania Hotel. Following are some papers of special interest to petroleum refiners that the society will present:

"Sources of Defects Located by Non-destructive Testing," by Carl E. Betz, Magnaflux Corp.

"Radiography," by Royal G. Tobey, Eastman Kodak Co.

"Magnetic Particle Inspection," by W. E. Thomas, Magnaflux Corp.

"Penetrant and Eddy Current Testing," by Hamilton Migel, Magnaflux Corp.

Ultrasonic Inspection: "Reflection Testing," by John C. Smak, Sperry Products; "Resonance Testing," by Peter K. Bloch, Branson Instrument Co.; and "Immersion Testing," by J. B. Morgan, Aluminum Co. of America.

"Evaluation of Indications of Discontinuities," by James H. Bly, X-Ray, Inc.

## NACE Plans Permian Basin Corrosion Tour Oct. 12-14

ANOTHER corrosion tour will be sponsored by the Permian Basin Section of the National Association of Corrosion Engineers from October 12 to 14. Headquarters will be the Lincoln Hotel in Odessa, Texas.

The tour has become a biennial event of the association and covers about 3000 sq. mi. of territory, the group travelling in air-conditioned buses. Some 300 pieces of equipment will be examined, their histories discussed, coatings named and the failures accounted for. Over 250 people are expected to attend and each will get a copy of the exhibit discussions and papers.

## NLGI Annual at Chicago From Oct. 31 to Nov. 2

The 23rd annual meeting of the National Lubricating Grease Institute will be held from Oct. 31 to Nov. 2 at the Edgewater Beach Hotel in Chicago. The opening address, "The U.S. Needs Highways for Survival," will be given by Maj. Gen. Frank D. Merrill, ret., commissioner of public works and highways for New Hampshire.

Among the symposiums to be given is "Flow Properties of Lubricating Greases," a panel discussion led by Nick Marusov, Gulf Research & Development Co. Some papers are: "Comparison of Grease Bleeding Tests with Field Storage," by J. L. Cooley, California Research Corp.; "Anti-Oxidants for Greases," by S. Fred Calhoun, U. S. Ordinance Corps; "High Temperature Ultra High Speed Grease Lubrication," by J. P. Dilworth and

Hoke toggle valves open and close with a single, positive motion like flipping a light switch. Use them on your precision test equipment for gas or liquid control at pressures up to 1000 psi. Seat and stem seals are tight enough for most vacuum work.

In instrument panel service you can tell instantly that the valve is open (or closed) and the colored nylon handles identify fluids at a glance.

Available in angle and globe patterns in brass or stainless, ⅛" through ½" pipe (or with tube fittings).

*May we send you catalog and data sheets?*

HOKE

**HOKE INCORPORATED**
Fluid Control Specialists
161 S. DEAN STREET, ENGLEWOOD, N. J.

**FOR EFFICIENT FILTER OPERATION**

***Switch to***

**ANTHRAFILT**
Trade Mark Reg. U.S. Pat. Off.

***"the modern filter medium"***

**USED BY MANY LEADING OIL COMPANIES FOR:**

- Filtration of Water for Repressure Pumping.
- Filtration of Sanitary and Cooling Water Supplies.
- Filtration of Spent Doctor and Process Wash Waters.
- Boiler Feed Water Supplies.
- Removal of Oily Condensates.
- Prevention of Pollution by Refinery Wastes.

**ANTHRAFILT** can be used in any filter requiring a filter media. Get the benefit of higher rates, longer runs and lower backwash requirements, along with a better quality of filter effluent.

**ANTHRAFILT**, being essentially a pure carbon, is not affected by acid or alkaline solutions.

Additional Information, Recommendations and Quotations Furnished on Request By:

**PALMER FILTER EQUIPMENT CO**
**P. O. Box 1696—822 E. 8th St., Erie, Pa.**
Representing ANTHRACITE EQUIPMENT CORP.
Anthracite Institute Bldg., Wilkes-Barre, Pa.

NOW!

*Electronic*
LIQUID
LEVEL
CONTROL by FISHER®

Fisher Governor Company widens its scope of liquid level measurement and control with the Fisher "Belmont Series" of capacitance type electronic liquid level controllers.

The "Belmont" can be used on most non-adhesive liquids—chemicals, oil, water, refrigerants, liquefied gases. Operating temperature ranges of the sensing elements are from 500° F. to -425° F. Operating pressure range is vacuum to 50,000 psi or higher.

Only two simple adjustments for liquid and differential control.

*Fisher Governor Company has purchased the Thermo Instruments Company, Belmont, California, which has manufactured and marketed the "Belmont" liquid level control the past ten years.*

**Write for Bulletin F-100**

**FISHER GOVERNOR COMPANY • Marshalltown, Iowa**

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER

*Our 75th*
ANNIVERSARY

J. R. Roach, The Texas Co.; and "Picker Lube Pay Off," by John L. McCollister, United Petroleum Corp.

### Consultants to Offer Symposium and Dinner

The annual meeting of the Association of Consulting Chemists and Chemical Engineers will feature a symposium on "How to Buy and Sell Consulting Services." The event will take place at the Hotel Belmont Plaza, New York City, on Oct. 25. The group's annual meeting traditionally follows a cocktail hour and banquet. The cocktail hour is to begin at 5 p.m.

The guest speaker on the symposium will be S. F. Coneybear, director of research, Colgate - Palm - Olive Co. Moderator will be Richard L. Moore, director of public relations for Foster D. Snell, Inc. Questions will be received from the floor.

### Offer 2nd Symposium on Vacuum Technology

A SECOND Symposium on vacuum technology will be held October 13 to 15 at the Mellon Institute, Pittsburgh. The event, like its predecessor, will be sponsored by the Committee on Vacuum Techniques, whose president is Rudy Koehler of Boston, Mass.

The program of the Second Symposium will deal with equipment, instrumentation, fundamental developments in vacuum technology, standards, nomenclature, methods and techniques, and some applications and processes of vacuum systems.

### Automatic Control Loops Topic of ISA Symposium

AUTOMATIC Control Loops — Electronic or Pneumatic? is the theme of this year's symposium of the Philadelphia Section, Instrument Society of America. The meeting will be held on October 28 and 29 at the Penn Sherwood Hotel in Philadelphia.

The advantages of both electronic and pneumatic control systems will be considered, as well as the overall costs of typical systems of each type, including installation, service, and maintenance.

An Instrument Fair will augment the discussions, giving manufacturers a chance to exhibit the latest automatic measurement and control devices.

### Boston Site of Joint Computer Conference

Three technical groups will sponsor the Eastern Joint Computer Conference Nov. 7-9 at the Hotel Statler, Boston. They are the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Association for Computing Machinery.

Some of the papers to be presented during the conference follow:

"Operations Control with an Electronic Computer," by Benjamin F. Butler, General Electric Co.

"The Computer and its Peripheral Equipment," by N. Rochester, International Business Machines Corp.

"Computers with Remote Data Input," by Edward L. Fitzgerald, du Pont Co.

"Developments in Programming Research," by Charles W. Adams, Westinghouse Electric Corp.

### Oil Man's Calendar

OCTOBER

*Lubrication Conference*, sponsored by the American Society of Mechanical Engineers and the American Society of Lubrication Engineers, Antler's Hotel, Indianapolis, Ind., Oct. 10-12.

*National Assn. of Corrosion Engineers*, Permian Basin Section, Corrosion Tour, Lincoln Hotel, Odessa, Oct. 12-14.

*California Natural Gasoline Assn.*, fall meet-


NEW! SIMPLEST GATE VALVE LINE BLIND on the market!

NO BOLTS TO LOOSEN!
NO LIFTING OF PLATES!
NO SPREADING OF LINE!
...just turn hand wheel

● Revolutionary design provides greater dependability, economy and ease of operation. Works on the gate valve principle. The rising stem raises the blind plate from the valve body into line with a machined carrier track incorporated in the top of the valve yoke. Here the blind plate merely slides off the stem onto the carrier track, and the other blind or spectacle plate is then slid onto the valve stem and lowered into position. "O" ring seal makes unit positive as a shut-off blind.

PATENTED

Write for full details today.

GREENWOOD GATE VALVE LINE BLIND
GREENWOOD VALVE DIVISION
VERNON TOOL CO., LTD.
1101 MERIDIAN AVENUE • ALHAMBRA, CALIFORNIA

You will need a REPRINT for your own files of:

IT'S TIME TO TAKE A NEW LOOK AT

CATALYTIC REFORMING

The Special 48-page Report in the August issue.

Single copies – $.75 Postpaid

Order From: Reader's Service Dept.
PETROLEUM PROCESSING
330 West 42nd Street
New York 36, N. Y.

*New York City residents, add 3% city sales tax*

ing, Ambassador Hotel, Los Angeles, Oct. 13-14.

*American Institute of Chemical Engineers*, South Texas Section, Hotel Galvez, Galveston, Oct. 14.

*2nd Symposium on Vacuum Technology*, Committee on Vacuum Techniques, Mellon Institute, Pittsburgh, Oct. 13-15.

*American Gas Assn.*, annual convention, Los Angeles, Oct. 17-19.

*37th National Metal Congress and Exposition*, Society for Non-Destructive Testing, et al., Philadelphia, Oct. 17-21.

*National Assn. of Corrosion Engineers*, South Central Region, Shamrock-Hilton Hotel, Houston, Oct. 18-21.

*American Institute of Chemical Engineers*, New York Section, Hotel Statler, New York, Oct. 20.

*Western Petroleum Refiners Assn.*, regional technical-industrial relations meeting, Garrett Hotel, El Dorado, Ark., Oct. 20-21.

*Assn. of Consulting Chemists and Chemical Engineers*, annual dinner and symposium, Hotel Belmont Plaza, New York City, Oct. 25.

*Instrument Society of America*, Philadelphia Section, "Automatic Control Loops—Electronic or Pneumatic?", Penn Sherwood Hotel, Philadelphia, Oct. 28-29.

*National Gasoline Assn. of America*, Southern Regional Meeting, Captain Shreve Hotel, Shreveport, La., Oct. 28.

*National Lubricating Grease Institute*, annual meeting, Edgewater Beach Hotel, Chicago, Oct. 31-Nov. 2.

NOVEMBER

*1st Symposium on Solar Energy*, Assn. for Applied Solar Energy, Westward Ho Hotel, Phoenix, Nov. 1-5.

*Society of Automotive Engineers*, golden anniversary diesel engine meeting, The Chase, St. Louis, Nov. 2-4.

*Society of Automotive Engineers*, golden anniversary fuels and lubrication meeting, Hotel Bellevue Stratford, Philadelphia, Nov. 9-10.

*Eastern Joint Computer Conference*, American Institute of Electrical Engineers, et al., Hotel Statler, Boston, Nov. 7-9.

*National Assn. of Corrosion Engineers*, Western Region, corrosion problems in the process industries, U. of California Extension Bldg., San Francisco, Nov. 14-17.

*American Petroleum Institute*, annual meeting, Mark Hopkins, Fairmont, St. Francis, and Palace Hotels, San Francisco, Nov. 14-17.

*2nd International Automation Exposition*, Navy Pier, Chicago, Nov. 14-17.

*American Institute of Chemical Engineers*, annual meeting, Statler Hotel, Detroit, Nov. 27-30.

DECEMBER

*Synthetic Organic Chemical Manufacturers Assn.*, annual dinner, Commodore Hotel, New York, Dec. 1.

*American Chemical Society*, Southwest Meeting, Shamrock Hotel, Houston, Dec. 1-3.

*National Gasoline Assn. of America*, Panhandle-Plains Regional Meeting, Herring Hotel, Amarillo, Texas, Dec. 2.

*25th Exposition of Chemical Industries*, Commercial Museum and Convention Hall Philadelphia, Dec. 5-9.

JANUARY

*Society of Automotive Engineers*, annual meeting, Sheraton-Cadillac and Statler Hotels, Detroit, Jan. 9-13.

*Symposium on Instrumentation for the Process Industries*, Texas A & M., College Station, Jan. 25-27.


...You can't beat these drop-head dies for easy work, perfect threads... and long trouble-free service!

Every RIDGID Pipe Tool TESTED before shipment

RIDGID

Drop-Head Dies

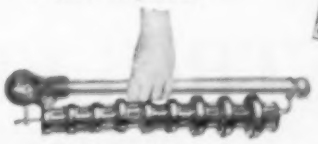
for ⅛" to 2" pipe

Each size die head snaps instantly into ratchet handle. Dies reverse quickly for close-to-wall threads, easily removed for regrinding. Left hand dies available.

00R, ⅛" to 1"
111R, ⅛" to 1¼"
12R, ⅛" to 2"

Buy them from your Supply House.

Every RIDGID Pipe Tool individually TESTED before shipment.

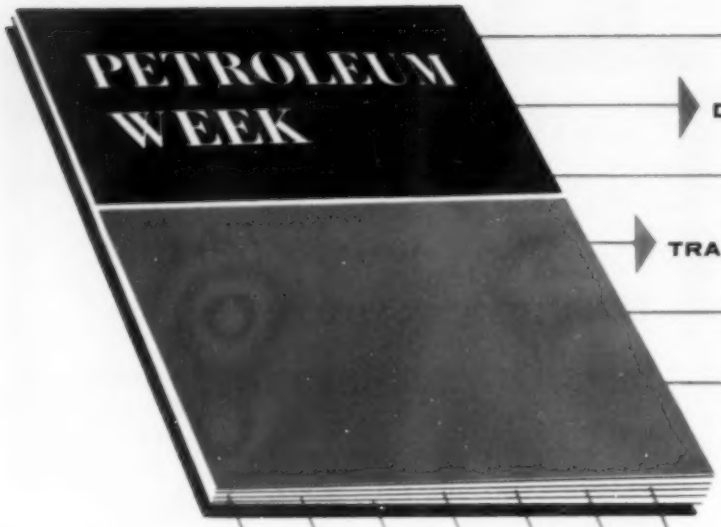


Carrier free with complete sets.

The Ridge Tool Company • Elyria, Ohio • U.S.A.




(To obtain more data on advertised products see page 1628)




# For industry-wide, industry-deep coverage

**PETROLEUM WEEK KEEPS EACH BRANCH OF THE INDUSTRY UP TO DATE ON DEVELOPMENTS AFFECTING THE INDUSTRY AS A WHOLE.**

Petroleum Week is written for oil men by oil and business communications experts. It reports and interprets in clear, concise language understandable to oil men at all levels of every segment

Designed around the new art of writing for variable-speed reading, Petroleum Week can be read easily and efficiently—at a fast tempo and with complete comprehension

ENGINEERING
MANAGEMENT
OPERATIONS
MAINTENANCE
GEOLOGY
PURCHASING
CONTRACTING

# PETROLEUM WEEK

A McGRAW-HILL PUBLICATION

330 West 42nd St., New York 36, N.Y.

Cross *Communications for Men Who Matter in Oil*


*(To obtain more data on advertised products see page 1628)*

# "Ye Compleat" Cost Estimator

**Chemical Engineering Cost Estimation,** by Robert S. Aries and Robert D. Newton, 1955, 9¼ x 6¼ in., 263 pages, indexed, illustrated, stiff cloth cover, $6.00, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Undoubtedly one of the most complete works of its kind, *Chemical Engineering Cost Estimation* is a practical "working" book. Extensive quantitative data—in the form of graphs, tables and formulae—along with outlines of the basic principles of cost estimation and evaluation make this book a valuable tool for a wide range of petroleum processing and chemical activities. Chemical engineers, chemists, accountants, market researchers, and other executives will find that *Chemical Engineering Cost Estimation* serves to bridge the gap between the technical details of a project and the economic factors.

Mr. Aries of R. S. Aries & Associates (Polytechnic Institute of Brooklyn) and Mr. Newton of Charles Pfizer & Co., Inc., co-authored this first single volume to cover the entire scope of cost estimating. More than 80 charts and graphs are included for the determination of costs for specific equipment items or economic factors. In addition each aspect of cost estimating which enters into the total installed or operating plant is included in the text.

Typical chapter headings are "Capital Investment," "Physical-plant Cost: Equipment," "Physical - plant cost: Components Other Than Equipment," "Manufacturing Cost," "General Expense," "Sales and Profits," "The Effect of Variable Conditions upon Costs and Profits," "Cost Factors in Plant Location," "The Relative Importance of the Components of Cost" and "Economic Evaluation."

## Industry's Role in Training Engineering Employees

*How to Train Engineers in Industry,* prepared by Professional Engineers Conference Board for Industry in cooperation with The National Society of Professional Engineers, 1955, 6 x 9 in., 72 pages, table of contents, illustrated, $2.00, Professional Engineers Conference Board for Industry, 1121 Fifteenth St. N.W., Washington 5, D.C.

The technical recruiting manager of a big electrical equipment manufacturing concern wrote facetiously, not so long ago in a company magazine, what the preparation industry would like its young engineers to have would include "a basic four-year engineering course, topped off by graduate work in a specific field, plus the physics or math of a doctorate, superimposed on a liberal arts background, with a survey of economics added."

Since such paragons don't just walk into recruiting offices, and colleges can provide only so much training during a limited time, industry is accepting the responsibility for providing its young engineers with the specific training needed to meet operational requirements. It has been estimated that some five to ten billion man-hours now are devoted annually to training in American industrial concerns.

The problem, however, is not simple. Today there is a striking lack of uniformity in training methods or scope, not only between different industries, but between different companies within the same industry or engineering field.

In an effort to untangle the confusion, the Engineers' Council for Professional Development, a group composed of leading national engineering organizations, began a study of the problem from the standpoint of the needs of the young engineer. From that study, begun in the 1940's, came a report in 1950, *The First Five Years of Professional Development,* in which a basic six-point program for the development of young graduate engineers was outlined.

Following this came the *Executive Research Survey* series analyzing the problems that management and engineers face in industry.

This series now includes four publications. In addition to the currently reviewed *How to Train Engineers in Industry,* preceding numbers in the series include *How to Attract and Hold Engineering Talent, How to Improve the Utilization of Engineering Manpower* and *How to Improve Engineering - Management Communication.*

*How to Train Engineers in Industry* has resulted from a survey of more than 200 companies employing a total of 1,531,254 persons including large numbers of engineers. These companies were sent detailed questionnaires asking details on their training programs including "philosophy", training the trainers, orientation and indoctrination, rating and evaluation, training for a better job and guidance toward professionalism. The answers to these questions are listed, giving the types of companies and percentage replies received.

The final portion of the book presents the Board's recommendations on what industry can do in the training of engineers to make more valuable employes.

## Recent Books Briefly Noted

**Pipe Friction Manual,** 1954, 8½ x 11 in., 87 pp., table of contents, illustrated, paper cover, $1.75, The Hydraulic Institute, 122 E. 42nd St., New York 17, N.Y.

. . . covers formulae; chart and table construction; friction losses for pipes from ⅛-in. to 84-in. diameter; resistance of valves and fittings; calculation methods; friction factor diagrams; viscosity definitions, index, blending chart, conversion, of common liquids; cast iron pipe dimensions; etc.

**Thermodynamic Properties of Methane-Nitrogen Mixtures,** O. T. Bloomer, B. E. Eakin, R. T. Ellington and D. C. Gami, 1955, 8½ x 11 in., 52 pp., table of contents, illustrated, $3.50, Institute of Gas Technology, 17 W. 34th St., Technology Center, Chicago 16, Ill.

. . . gives the thermodynamic properties of two mixtures, 90% methane-10% nitrogen, and 70% methane-30% nitrogen, and a demonstration of use of the data in computing energy requirements of nitrogen-separation processes.

**Basic Lubrication Practice,** Allen F. Brewer, 1955, 6¼ x 9 in., 286 pp., indexed, illustrated, stiff cover, $6.75, Reinhold Publishing Corp. 430 Park Ave., New York 22, N.Y.

. . . tells how to choose and use the most effective lubricant for industrial and power equipment such as bearings, gears, chains, wire rope, flexible couplings, cams, steam turbines and cylinders, internal combustion engines, etc.

**Organic Syntheses,** Collective Volume III, edited by E. C. Horning, 9¼ x 6¼ in., 890 pp., indexed, illustrated, stiff cloth cover, $15.00, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y.

. . . encompasses all material in Annual Volumes 20-29, revised and brought up to date with errors corrected and calculations and references checked; gives detailed method of synthesis for over 300 organic compounds from acenaphthenequinone to vinyl chloroacetate.

# Information Offered in the Advertisements

*Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.*

ALUMINUM, for refinery applications, booklets; Aluminum Co. of America. See adv't. p. 1643.

ANTIOXIDANT, for improving gasoline quality, bulletin; Koppers Co. See adv't. p. 1615.

BUBBLE CAPS, 300 styles listed in bulletin 22; Pressed Steel Co. See adv't. p. 1638.

CATALYSTS, many types in various forms, booklet; Harshaw Chemical Co. See adv't. p. 1527.

CATALYSTS, and catalyst recovery, platinum, booklets; Baker & Co. See adv't. p. 1536.

CATALYTIC REFORMING, booklet; Atlantic Refining Co. See adv't. p. 1657.

CLEANING COMPOUNDS, for exchangers, towers, etc., guide book; Oakite Products, Inc. See adv't. p. 1654.

DE-WAXERS, de-oilers, rotary drum vacuum filters, test data; Goslin-Birmingham Mfg. Co. See adv't. p. 1516.

DRYING EQUIPMENT, for air, gas and organic liquids, booklet; Pittsburgh Lectrodryer Corp. See adv't. p. 1539.

ENTRAINMENT SEPARATORS, hi-thruput, booklet ME-5; Metal Textile Corp. See adv't. p. 1600.

FLOW INDICATORS, for slight flows, data unit available; Jerguson Gage & Valve Co. See adv't. p. 1645.

FLOW MEASUREMENT, bulletin 115-L1; Builders-Providence. See adv't. Cover 2.

FLUID HYDROFORMER, description of new installation in "Heat Engineering"; Foster Wheeler Corp. See adv't. p. 1538.

FURFURAL, for solvent extraction, bulletin 203-A; Quaker Oats Co. See adv't. p. 1549.

LIQUID LEVEL CONTROL, electronic capacitance type, bulletin F-100; Fisher Governor Co. See adv't. p. 1621.

MANOMETERS, absolute and differential, for pressure and vacuum, information; Emil Greiner Co. See adv't. p. 1638.

MASS SPECTROMETRY, for process monitoring, two models, bulletin CEC 1824A-X25; Consolidated Engineering Corp. See adv't. p. 1611.

MECHANICAL SEALS, rotary, alloy, bulletin 455-PP; Durametallic Corp. See adv't. p. 1646.

MECHANICAL SEAL, rotates with shaft, "Teflon," bulletin MS-954; U. S. Gasket Co. See adv't. p. 1652.

METAL DEACTIVATOR, prevents fuel line clogging, booklet; DuPont Co. See adv't. p. 1608.

MIXERS, side and top entering, nine catalogs available; Mixing Equipment Co. See adv't. p. 1552.

MOTOR STARTERS, for hazardous locations, booklet 1062; Electric Controller & Mfg. Co. See adv't. p. 1656.

OXYGEN ANALYZER, direct continuous measurement, data file 16J-105; A. O. Beckman, Inc. See adv't. p. 1650.

PAINT, aluminum, two booklets; Aluminum Co. of America. See adv't. p. 1533.

PRESSURE TUBING, heat exchanger, bulletin TB-329; Babcock & Wilcox Co. See adv't. p. 1649.

PUMP, for liquids, gases and slurries, catalog; Sigmamotor, Inc. See adv't. p. 1645.

REFRACTORY GRAIN, many uses, new booklet; Norton Co. See adv't. p. 1586.

SORPTIVE MINERALS, for varied applications, booklet, technical data and samples; Minerals & Chemicals Corp. See adv't. p. 1529.

STEAM TRAPS, three parts, catalog 953; W. H. Nicholson & Co. See adv't. p. 1520.

STEEL PLATE, for towers, general catalog; Flint Steel Corp. See adv't. p. 1648.

TERMINAL FACILITIES, storage and transport, booklet; Hess Terminal Corp. See adv't. p. 1636.

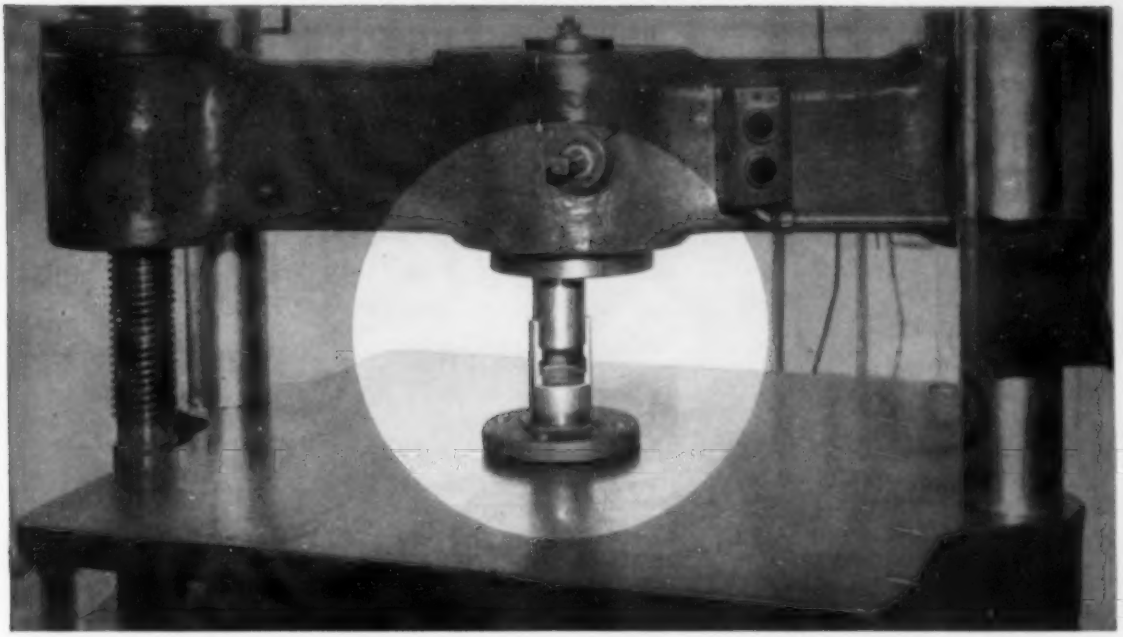
TEMPERATURE RECORDING, various ranges, types, catalog; Electric Auto-Lite Co. See adv't. p. 1646.

TRAPS, many types, bulletins 289, 450, 2091 and catalog J; Armstrong Machine Works. See adv't. p. 1546.

TUBING, heat exchanger and condenser, booklet and catalog; Wolverine Tube. See adv't. pp. 1604A-1604B.

VALVES, gate, line blind, information on request; Vernon Tool Co. See adv't. p. 1622.

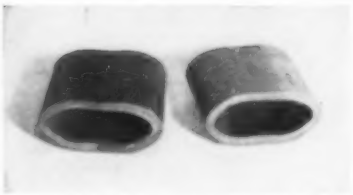
VALVES, toggle, for instrument panels and test equipment, data sheets and catalog; Hoke, Inc. See adv't. p. 1620.



**Bond holds despite shear** exerted by mandrel on lead lining in test section of "Tubond" pipe.

# Now...in "Tubond" pipe...a bond stronger than the tensile strength of lead

## *National Lead's improved bonding process inseparably weds lead to steel*



**Squeeze it, abuse it** . . . no breaks appear in the casing, lining, or bond.

**Twisted once, twisted twice** . . . the second time in the reverse direction. No bond failure.

Twist it. Crush it. Manhandle it.

You just can't strip the lead lining away from National Lead's "United Tubond"® lead-lined pipe. The lining will "give" but not the bond.

Look at the test above. Here a mandrel, sized to the ID of the steel pipe minus a few thousandths, is forced through "Tubond" pipe. (A part of the side wall is cut away to show what happens.)

The lead flows, of course, and accumulates below the mandrel. But it doesn't actually pull away from the steel pipe. A thin layer of lead still remains bonded to the steel.

Now look at the twisted and crushed sections. No separation despite massive distortion. With pressure, vacuum, heat, vibration, it's the same story . . . no separation.

What weds the lead to the steel is National Lead's improved bonding process.

### Proves virtually indestructible

In service, too, this bond provides an anchorage for the lining that minimizes any chance of acid leakage.

So for maximum corrosion protection, coupled with maximum mechanical strength, specify "United Tubond" pipe. Where conditions are less rigorous you may want to look into "United" expanded lead-lined pipe.

National Lead's technical specialists will be glad to help you work out the technical details of corrosion-resistant systems . . . piping, valves, pumps, coils, tanks and other elements. Just call the nearest office below.

**NATIONAL LEAD COMPANY:** New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 80; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.) Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Ltd.).



*(To obtain more data on advertised products see page 1628)*

# ADVERTISERS' INDEX

This index is published as a convenience to the reader. Every care is taken to make it accurate, but PETROLEUM PROCESSING assumes no responsibility for errors or omissions.

**FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW**

**Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products, or services which interest him. This code letter appears in parentheses following the advertiser's name.**

•

**Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.**

**Fill in your name, title, company and mailing address and mail the card . . . no postage is required.**

**The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.**


A

Airetool Mfg. Co. (I-4) 1642
Air Preheater Corp. (B-9) 1531
Aluminum Co. of America, Pigments Div. (C-2) 1533
Aluminum Co. of America, Process Equip. Div. (I-5) 1643
American Cyanamid Co., Refinery Chem. Dept. (D-7) 1548
Anaconda Co. (E-8) 1601
Anthracite Equipment Corp. (G-7) 1620
Armstrong Machine Works (D-5) 1546
Atlantic Refining Co. (K-3) 1657

B

Babcock & Wilcox Co., Tubular Prods. Div. (J-4) 1649
Babcock & Wilcox Co., Boiler Div. (B-6) 1528
Baker & Co. (C-4) 1536
Beckman, Inc., Arnold O. (J-5) 1650
Betz, W. H. & L. D. (G-4) 1617
Bigelow-Liptak Corp. (H-6) 1635
Black, Sivalls & Bryson, Inc. (I-6) 1644
Blaw-Knox Co. (E-3) 1581
Brown Fintube Co. (H-8) 1637
Builders-Providence, Div. of B-I-F Industries (A-1) Cover 2

C

Chemax Mfg. Co. (E-9) 1602
Chicago Bridge & Iron Co. (J-6) 1651
Cities Service Co. (J-8) 1653
Consolidated Engr. Corp. (F-7) 1611
Cooper-Bessemer Corp. (B-3) 1525
Crane Co. (J-2) 1647

D

Davison Chemical Co., Div. W. R. Grace & Co. (A-3) 1509
Dempster Brothers, Inc. (C-3) 1534-1535
Dow Chemical Co. (I-3) 1641
DuPont de Nemours & Co., Inc. (B-2) 1524A-1524B
DuPont de Nemours & Co., Inc. (F-6) 1608
Durametallic Corp. (I-9) 1646

E

Eastern Industries, Inc. (F-2) 1603
Electric Auto-Lite Co. (J-1) 1646
Electric Controller & Mfg. Co. (K-2) 1656
Enjay Co. (E-6) 1598
Ernst Water Column & Gage Co. (G-1) 1612
Ethyl Corp. 1582-1583

F

Fisher Governor Co. (G-8) 1621
Flint Steel Corp. (J-3) 1648
Foster Wheeler Corp. (C-6) 1538

G

Gen'l. Amer. Trans. Corp., Plate & Welding Div. (A-4) 1510
Gen'l. Amer. Trans. Corp., Terminals Div. (A-5) 1512
Gen'l. Chemical Div., Allied Chem. & Dye Corp. (K-5) Cover 3
General Refractories Co. (C-9) 1541
Glitsch & Sons, Inc., F. W. (I-2) 1640
Goslin-Birmingham Mfg. Co. (A-7) 1516
Graver Tank & Mfg. Co. (C-8) 1540
Greiner Co., Emil (I-1) 1638
Gustin-Bacon Mfg. Co. (D-3) 1544

H

Harshaw Chemical Co. (B-5) 1527
Hercules Powder Co. (B-8) 1530
Hess Terminal Corp. (H-7) 1636
Hoke, Inc. (G-6) 1620
Houdry Process Corp. (C-1) 1532

J

Jerguson Gage & Valve Co. (I-7) 1645

K

Kaiser Engineers (B-1) 1524
Kellogg Co., M. W. (E-1) 1550-1551
Key Co. (D-2) 1543
Koppers Co., Inc. (G-3) 1615
Kuljian Corp. (F-9) 1612

L

Lukens Steel Co. (G-2) 1614
Lummus Co. (A-6) 1515

M

McKee Co., Arthur G. (D-6) 1547
Metal Textile Corp. (E-7) 1600
Minerals & Chemicals Corp. (B-7) 1529
Mixing Equipment Co. (E-2) 1550

N

National Lead Co. (H-2) 1627
Nicholson & Co., W. H. (A-9) 1520
Norton Co. (E-5) 1586

O

Oakite Products, Inc. (J-9) 1654
Oil Well Supply Co. (A-2) 1505
Olin Mathieson Chem. Corp. (G-5) 1618
Oronite Chemical Co. (A-8) 1519

P

Petro-Chem Dev. Co., Inc. (E-4) 1584
Pittsburgh Corning Corp. (D-1) 1542
Pittsburgh Lectrodryer Corp. (C-7) 1539
Powell Co., William (C-5) 1537
Pressed Steel Co. (H-9) 1638

Q

Quaker Oats Co. (D-9) 1549

R

Refinery Engineering Co. (F-5) 1607
Ridge Tool Co. (H-1) 1623
Rockwell-Nordstrom Valves (D-8) 1548A-1548B

S

Santa Fe Tank & Tower Co. (K-6) Cover 4
Sauereisen Cements Co. (F-8) 1611
Sigmamotor, Inc. (I-8) 1645
Struthers Wells Corp. (B-4) 1526

T

Taylor Instrument Cos. (K-4) 1658-1659
Tennessee Eastman Co., Eastman Chemical Prods. (D-4) 1545
Tickle Engr. Works, Arthur (H-3) 1631
Tretolite Co. (F-3) 1604

U

Union Carbide & Carbon, Haynes Stellite Co. (K-1) 1655
U. S. Gasket Co. (J-7) 1652
Universal Oil Products Co. (H-4) 1632-1633

V

Vernon Tool Co. (G-9) 1622

W

Wallace & Tiernan Prods., Inc. (H-5) 1634
Washington Aluminum Co., Inc. (F-1) 1602
Wolverine Tube, Div. Calumet & Hecla, Inc. (F-4) 1604A-1604B


**CLASSIFIED ADVERTISING**

F. J. Eberle, Ass't. Mgr.


EMPLOYMENT OPPORTUNITIES 1616
EQUIPMENT (Used or Surplus New) For Sale 1616

# SAVE TIME • SAVE EFFORT • KEEP INFORMED

## USE THIS CARD . . .

to secure information on products and services advertised in *Petroleum Processing* or reviewed in its *"What's New"* section.

FOR ADVERTISED PRODUCT INFORMATION:
Check the Advertiser's Index for advertisement's code letter. Then circle the corresponding code letter on the card below.

FOR "WHAT'S NEW" PRODUCT INFORMATION:
Circle the code number on the card below which corresponds to the number listed at the end of that specific "What's New" item.

THEN:
Fill in your name, position, company and mailing address. Mail the card . . . no postage is required.

**PETROLEUM PROCESSING READER SERVICE INFORMATION CARD—VOID AFTER JANUARY 15, 1956**

**"WHAT'S NEW" ITEMS**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
| 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 |
| 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 |
| 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |

**ADVERTISED PRODUCTS**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | B1 | C1 | D1 | E1 | F1 | G1 | H1 | I1 | J1 | K1 | L1 | M1 | N1 | O1 | P1 |
| A2 | B2 | C2 | D2 | E2 | F2 | G2 | H2 | I2 | J2 | K2 | L2 | M2 | N2 | O2 | P2 |
| A3 | B3 | C3 | D3 | E3 | F3 | G3 | H3 | I3 | J3 | K3 | L3 | M3 | N3 | O3 | P3 |
| A4 | B4 | C4 | D4 | E4 | F4 | G4 | H4 | I4 | J4 | K4 | L4 | M4 | N4 | O4 | P4 |
| A5 | B5 | C5 | D5 | E5 | F5 | G5 | H5 | I5 | J5 | K5 | L5 | M5 | N5 | O5 | P5 |
| A6 | B6 | C6 | D6 | E6 | F6 | G6 | H6 | I6 | J6 | K6 | L6 | M6 | N6 | O6 | P6 |
| A7 | B7 | C7 | D7 | E7 | F7 | G7 | H7 | I7 | J7 | K7 | L7 | M7 | N7 | O7 | P7 |
| A8 | B8 | C8 | D8 | E8 | F8 | G8 | H8 | I8 | J8 | K8 | L8 | M8 | N8 | O8 | P8 |
| A9 | B9 | C9 | D9 | E9 | F9 | G9 | H9 | I9 | J9 | K9 | L9 | M9 | N9 | O9 | P9 |

**PETROLEUM PROCESSING**
A McGRAW-HILL PUBLICATION

10/55

Name (Please Print) _____ Position _____

Company _____ Business Address _____

City, Zone _____ State _____

**PETROLEUM PROCESSING READER SERVICE INFORMATION CARD—VOID AFTER JANUARY 15, 1956**

**"WHAT'S NEW" ITEMS**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
| 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 |
| 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 |
| 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |

**ADVERTISED PRODUCTS**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | B1 | C1 | D1 | E1 | F1 | G1 | H1 | I1 | J1 | K1 | L1 | M1 | N1 | O1 | P1 |
| A2 | B2 | C2 | D2 | E2 | F2 | G2 | H2 | I2 | J2 | K2 | L2 | M2 | N2 | O2 | P2 |
| A3 | B3 | C3 | D3 | E3 | F3 | G3 | H3 | I3 | J3 | K3 | L3 | M3 | N3 | O3 | P3 |
| A4 | B4 | C4 | D4 | E4 | F4 | G4 | H4 | I4 | J4 | K4 | L4 | M4 | N4 | O4 | P4 |
| A5 | B5 | C5 | D5 | E5 | F5 | G5 | H5 | I5 | J5 | K5 | L5 | M5 | N5 | O5 | P5 |
| A6 | B6 | C6 | D6 | E6 | F6 | G6 | H6 | I6 | J6 | K6 | L6 | M6 | N6 | O6 | P6 |
| A7 | B7 | C7 | D7 | E7 | F7 | G7 | H7 | I7 | J7 | K7 | L7 | M7 | N7 | O7 | P7 |
| A8 | B8 | C8 | D8 | E8 | F8 | G8 | H8 | I8 | J8 | K8 | L8 | M8 | N8 | O8 | P8 |
| A9 | B9 | C9 | D9 | E9 | F9 | G9 | H9 | I9 | J9 | K9 | L9 | M9 | N9 | O9 | P9 |

**PETROLEUM PROCESSING**
A McGRAW-HILL PUBLICATION

10/55

Name (Please Print) _____ Position _____

Company _____ Business Address _____

City, Zone _____ State _____

## FOR MORE INFORMATION...

about products and services advertised in this issue of Petroleum Processing or reviewed in its "What's New" section, use the postage-free cards provided below.
(See other side for complete instructions.)

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P. L. & R.)
New York, N. Y.

BUSINESS REPLY CARD
No Postage Necessary if Mailed in the United States

4c-POSTAGE WILL BE PAID BY

**PETROLEUM PROCESSING**

**330 WEST 42nd STREET**

**NEW YORK 36, N. Y.**

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P. L. & R.)
New York, N. Y.

BUSINESS REPLY CARD
No Postage Necessary if Mailed in the United States

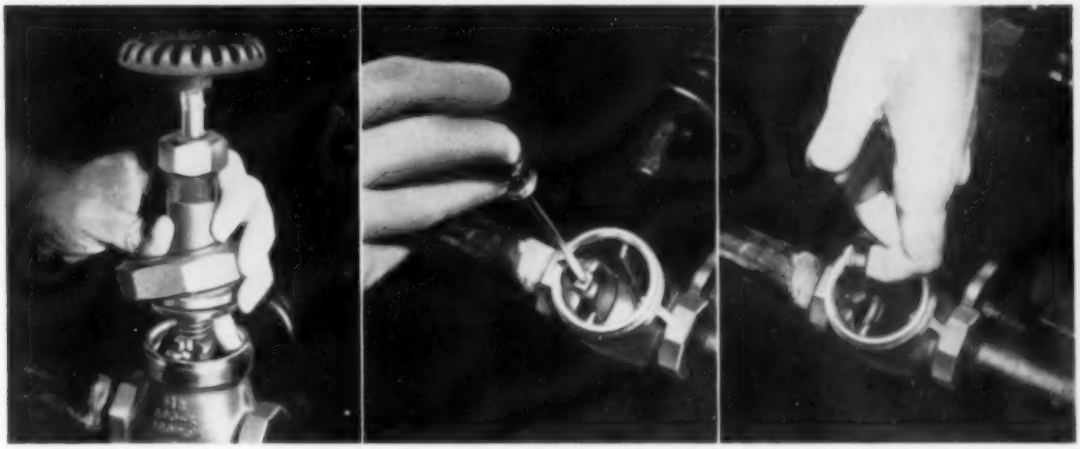
4c-POSTAGE WILL BE PAID BY

**PETROLEUM PROCESSING**

**330 WEST 42nd STREET**

**NEW YORK 36, N. Y.**

# WHAT'S NEW...



## Gate Valve Seat Ring Replaced in 10 Minutes

Without removing the valve from the line, a newly developed design permits rapid replacement of the seat ring in 7 to 10 minutes, using only a screwdriver. As illustrated above, the first step is to disassemble the two-piece union bonnet. The set screws are then removed, seat rings lifted out of the valve body and replaced, again being secured with the set screws.

The angle of the pointed end of the retaining screw is complementary to that of the seat ring. The resultant line of contact holds the ring securely and rigidly without excessive pressure on the screw. Screws are made of silicon bronze to prevent galling or freezing, and have a fine pitch thread.

Supplied with rising and non-rising stem, in ½, ¾, 1, 1¼, 1½, and 2-in. sizes, the new gate valve is said to be suitable for severe service conditions on 200 psi. steam, 400 psi. water, oil or gas lines requiring full flow and frequent operation. Seat rings are of Monel and wedges of nickel alloy construction. The Fairbanks Co., 393 Lafayette Street, New York 3, New York.

*Circle No.* **1** *on Reply Card*

### Small-Size Receivers

**. . . and gauges for pressure,** temperature, and draft permit greater compactness in instrument panel arrangements. Called the V5 Series, the new line has indicator scales 5 inches in height, yet they are said to be easy to read at a distance. Each gauge or receiver is an independent, self-contained unit and it may be grouped with as many as eight others in a single case or mounted individually. Full size diaphragm, bellows, or helices are used. Bellows units are available for the direct measurement of pressure up to 100 psi. or for receiving all standard pneumatic transmission pressures. Illuminated scales are standard. Bulbs may be replaced without removing the gauge from its case or disturbing the mounting. Scales may be color-coded in the field if desired. Duplex units with two pointers can be furnished if desired. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago 47, Ill.

*Circle No.* **2** *on Reply Card*

### New Pipe Dolly Design

**. . . for welding jobs** is of combination type and manufacturer claims it will reduce pipe handling time up to 85%. Use of the dolly involves setting the traveling heads in a partially closed position, loading the pipe in the dolly, checking the level, and rotating the adjustment handle to lower or raise the pipe until it is leveled. Rollers permit rotation for either manual or for automatic welding. The dolly can also be used to align pipe. It will handle loads to 2500 lb., sizes to 36 in. H & M Pipe Beveling Machine Co., Tulsa, Okla.

*Circle No.* **3** *on Reply Card*

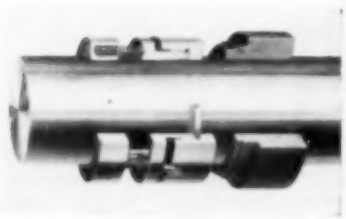
**For More Information**

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage is required.

### High Pressure Valve

**. . . provides precise settings** because of its micrometer stem. Designed for bleeding and metering pressure let-down control, this new "Micro-Valve" operates on the principle of differential screw threads. The slightest turn of the handle is said to make dial settings an easy-to-read record. One complete revolution of the handle opens the valve orifice 0.015 sq. in. There is a positive stop at full closed position, preventing the possibility of misalignment or over-pressure on the seat through excessive tightening. The valve is being manufactured in a wide range of materials including stainless steel, Hastelloy, and titanium, for pressures ranging from vacuum up to 60,000 psi. It is available in a complete range of tubing sizes through 9/16 in. High Pressure Equipment Co., Inc., 1222 Linden St., Erie, Penna.

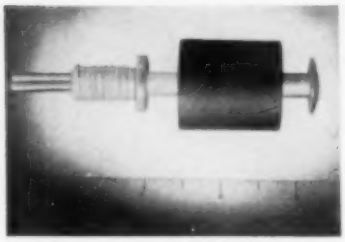
*Circle No.* **4** *on Reply Card*



### Rotary Mechanical Seal

**. . . for high temperature service** will handle hot oils or hot water at temperatures up to 800° F. Two adaptations of the seal are being offered: Type RHU — unbalanced assembly (illustrated) and Type PHU—balanced assembly. The seals can be installed easily on either new or existing equipment. Construction generally is of stainless steel, with durable wearing surfaces and stainless steel U-ring shaft packings. They do not require stuffing box flushings, unless to control vapor pressures in the box or to flush out any excessive coke formation which might be encountered in high temperature service. Durametallic Corp., 2104 Factory St., Kalamazoo, Mich.

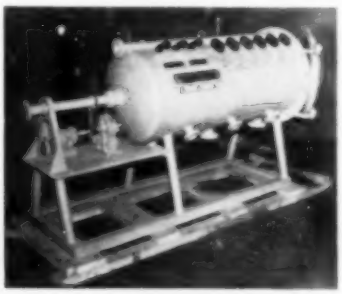
*Circle No.* **5** *on Reply Card*



### Float Level Indicator

**. . . may be used for control also,** has no exposed metal parts, and will handle solvents, oils, acids, and other chemicals. The F-8685 model uses a hermetically sealed, single-pole, single-throw switch, rated at a 10-watt load at 115 volts AC, 0.5 amp. resistive or inductive load at 28 volts DC (L/R—0.026) and has a 100,000 cycle minimum life. This switch is enclosed in a nylon stem and is actuated by permanent magnets imbedded in the free float. Nylon-jacketed leads, 18-gauge, extend through the threaded mount. The unit is 3.31 in. long (less leads) by 1.22 in. maximum diameter, and weighs 0.9 oz. Revere Corp. of America, Wallingford, Conn.

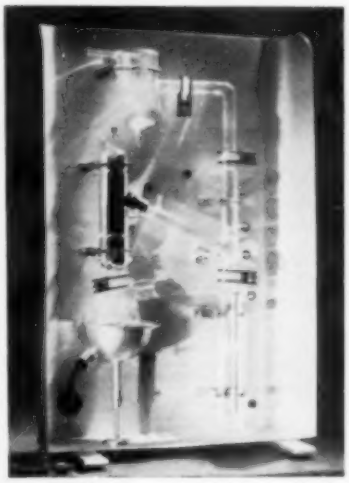
*Circle No.* **6** *on Reply Card*



### Self-Cleaning Filter

**. . . of pressure leaf type** is capable of handling up to 12,000 gal./hr. of flow. It is equipped with sight ports through which the individual filter leaves can be inspected. These ports can be dogged down quickly for the operation of the filter. Hercules Filter Corp., Hawthorne, N. J.

*Circle No.* **7** *on Reply Card*



### Vacuum Distillation Unit

**. . . of ASTM-type,** recently introduced by Glenlab, has been re-designed into a self-contained unit mounted in a metal shield for laboratory convenience. Facilities are provided for quick access to all parts requiring removal or adjustment during operation. The equipment, originally developed to coordinate with a standardization program relating to the use of ASTM-type distillation of lube oils and reduced crudes, is otherwise the same as that produced for Myers and Kiguchi of C. F. Braun & Co. The apparatus includes two condenser jackets, one surrounding the delivery tube from column to receiver and the second a vertical knock-back condenser for lighter materials. Distillation flask is of 500 ml. capacity, "Vycor" glass, with a thermometer well and a 35/25 socket joint. The silvered vacuum jacket is protected against thermal shock and expansion by internal-type expansion bellows. Internal silvering on the vertical condenser has a ¼-in.-wide full-length window. There is a 10/30 standard taper joint at the top of this condenser for the thermocouple. Glass Engineering Laboratories, 589 O'Neill Ave., Belmont, Calif.

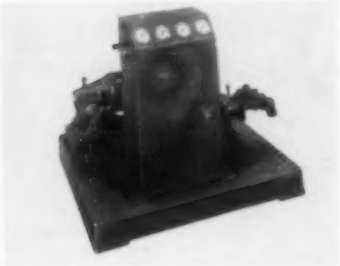
*Circle No.* **8** *on Reply Card*

### Small Power Operator

**. . . is pneumatically positioned.** The Model B-50 Cylinder Conomotor is a small version of the Series 50 line, capable of producing stroke lengths to 2 in. and thrusts of 300 lbs. in either direction. It is suitable for use with supply pressures to 100 psi. with a conventional 3-15 psi. signal range. It is said to be ideal for services where heavy loads require high accuracy

throttling in a minimum of space. Applications include positioning proportioning pumps, electrical components, turbine and compressor governors. Conoflow Corp., 2100 Arch St., Philadelphia 3, Penna.

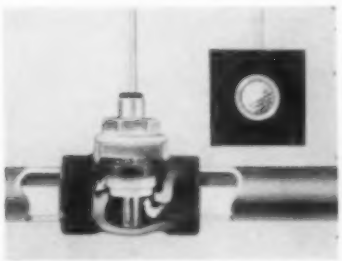
*Circle No.* **9** *on Reply Card*



### Controlled Volume Pump

. . . **has automatic adjustment** made by standard 3-15 psi. instrument air signals. Designed to solve specific low capacity flow control problems, the pump utilizes an air servo system with feedback loop to give capacity adjustments with an accuracy within 1%. Stroke length of the new pump is infinitely adjustable from 0 to 100% of full length by means of a reversible rotary air motor. This motor and the other components of the pneumatic servo system are housed in a 22-in.-high cabinet mounted on the pump base. Four easy-to-read gages show key air pressures at all times. Actual stroke length is indicated by a dial mounted on the pump. Sensitivity is such that 1/70 psi. change in instrument control air pressure causes resetting of pump stroke length. Milton Roy Co., Station N, 1300 East Mermaid Lane, Philadelphia 18, Penna.

*Circle No.* **10** *on Reply Card*



### New Flow Indicator

. . . **uses standard pipe fitting for body** to permit easy installation in any line by conventional methods. The Model

*Continued on page 1634*

NO.2 in a series of ALUMICOAT APPLICATIONS

RESISTS HIGH TEMPERATURE CORROSION!

Alumicoat Molten Aluminum PROCESS PROTECTS REFINERY EQUIPMENT

More and more refineries are discovering the advantages of the new ALUMICOAT Process! ALUMICOAT offers a firm resistance against corrosive media — *especially sulphur compounds* — and extreme temperatures!

In the ALUMICOAT Process, refinery parts are dipped in molten aluminum to produce a metallurgical iron-aluminum bond at the interface and a surface overlay of pure aluminum. At temperatures exceeding the melting point of aluminum, the aluminum on the surface diffuses. This diffused coating, together with the iron-aluminum bond, provides a refractory material that gives steel maximum protection against high temperature scaling.

The Alumicoat Process can solve your corrosion and oxidation problems. Send for full details today!

ARTHUR TICKLE ENGINEERING WORKS, INC.

24 Delevan Street MAin 5-4200 Brooklyn, N. Y.

PRIME TARGET

# OF PETROLEUM REFINING

*. . . better ways to make gasolines for tomorrow's engines!*

**UOP MAKES PETROLEUM PROCESSING MORE EFFICIENT . . . MORE ECONOMICAL . . . MORE PROFITABLE**

Developing processing methods to keep gasoline performance equal to automotive engine design has been one of UOP's main objectives for over four decades.

A long list of important contributions began with thermal cracking . . . the first practical process to make more and better motor fuels . . . and has expanded with new and improved processing methods that have continually found *industry-wide* acceptance.

## *Platforming a Success!*

Refiners, world-wide, now employ Platforming . . . the industry's first successful catalytic reforming process, originated and developed by UOP. The success of Platforming, under the widest possible range of operating conditions, is further evidence of the depth of technical knowledge and practical experience Universal applies to *every* processing problem.

## *Rexforming Now a Practical Reality!*

UOP's latest contribution to modern-day refining is Rexforming. Immediate acceptance of this process for the economical production of super fuels indicates that it is a worthy companion to the many successful processes that Universal's knowledge and technical skills have provided.

Announced this year, Rexforming is rapidly gaining recognition and will soon be contributing to the industry's ability to adequately meet market demands for better, more powerful gasolines.

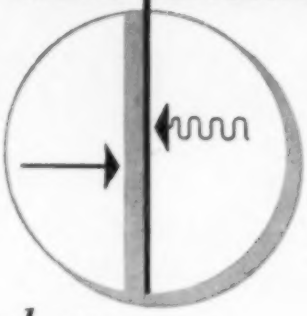
**UNIVERSAL OIL PRODUCTS COMPANY**

UOP 30 ALGONQUIN ROAD, DES PLAINES, ILLINOIS, U. S. A.

*Forty Years Of Leadership In Petroleum Refining Technology*

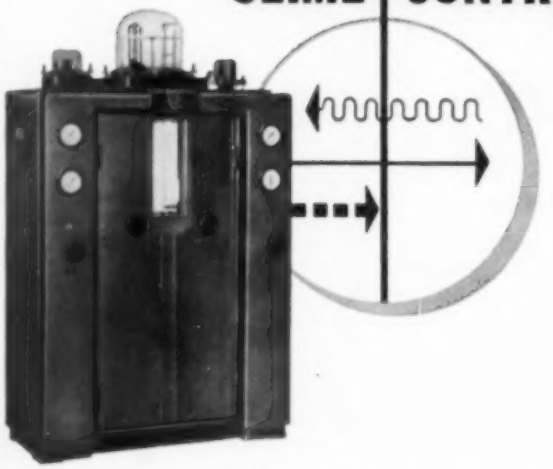
*Where you need*

**HEAT | EXCHANGE**



*Be sure you have*

**SLIME | CONTROL**



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

WALLACE & TIERNAN

25 MAIN ST., BELLEVILLE 9, N. J.

CHLORINATORS • CHEMICAL FEEDERS • SCREENING EQUIPMENT • MAGNETIC SEPARATORS • PRECISION PRESSURE INSTRUMENTS • CATHODIC PROTECTION • FINE CHEMICALS

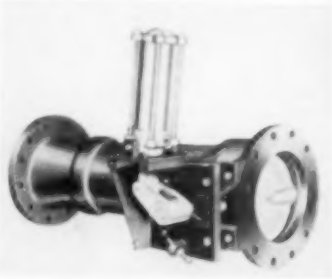
CD-39




*Continued from page 1631*

FI-200 is designed so that flow (or flow stoppage if desired) will actuate a switch for operating a warning signal, or it may be arranged for providing shut-down. Construction is of marine bronze and plastic, chemically inert to oil, fuels, and the like. Lead wires are duplex nylon jacketed. Switch unit is hermetically sealed in glass. The indicators are available in standard pipe sizes from ¼ to 3 in. Normal models are designed to function for any flow over 1.5 gpm.; others can be provided on special order. Gems Co., 64 Welles Drive, Newington, Conn.

*Circle No.* **11** *on Reply Card*



### Flow Rate Controller

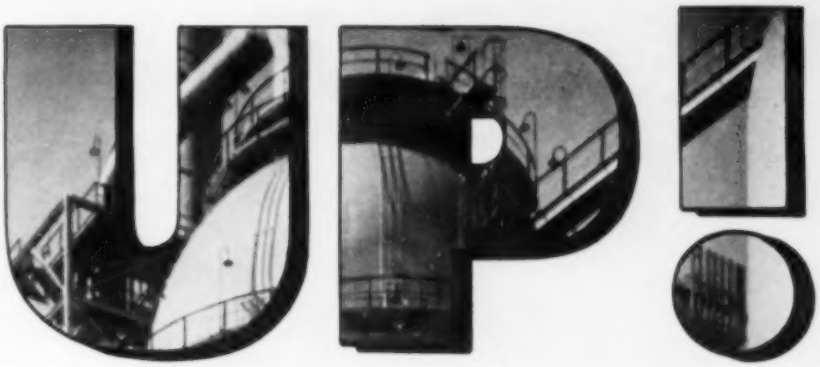
**. . . is power-actuated** for accurate control and tight-closing in water and waste services. The unit comprises a venturi metering section and a pressure recovery section, a power-actuated valve mechanism, and a pneumatic, hydraulic, or electric positioning control unit. The cast iron body, for working pressures up to 125 psi., has a pressure-averaging annulus at the inlet and a closed annular chamber with multiple vents at the throat. The bronze-lined venturi throat section is of proper diameter and contour for maximum accuracy and for freedom from corrosion and tuberculation. The Model RCB-T comes with a rubber-seated butterfly valve. Control accuracy is within ±3%, ranging from 25 to 100% of maximum capacity. Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.

*Circle No.* **12** *on Reply Card*

### Low Capacity Pump

**. . . maintains flow rates at high pressures** with continuous, smooth delivery. The Model 155 is said to have particular applications in research as well as processing, and will operate at pressures up to 10,000 psi. Air pressure operates the discharge valves and the hydraulic driving pump, which operates two double-acting hydraulic

# HOW TO KEEP PRODUCTION UP!



A few generations ago, John Ruskin had a few penetrating remarks to register on business—and what he said makes a lot of sense today.

"The common law of business practice," he commented, "prohibits paying a little and getting a lot. If you deal with the lowest bidder, it's well to add something for the risk you run. And if you do that, you will have enough left over for something better."

Let's translate this in terms of furnace construction for refineries. If you buy a heat enclosure for a job where high and continuous production is a must, then it's imperative that you invest in one that will stand the gaff. To make sure, you've got to build a unit which is properly engineered for the job it must do. You pay more, of course. But it's poor economy—and often embarrassing—to plow money back into repairs right at the peak of production.

That's all we have to say. You get sound engineering and a job designed to stay on stream when you come to Bigelow-Liptak. We've been designing refinery furnaces for years—erecting them, too. Both suspended and castable construction—the one that's best for the job—are used. Better investigate—right now!

FIRST COST OF AN INFERIOR JOB

PLUS REPAIRS AND LOST PRODUCTION

FIRST COST OF A BIGELOW-LIPTAK JOB

**BIGELOW-LIPTAK Corporation**

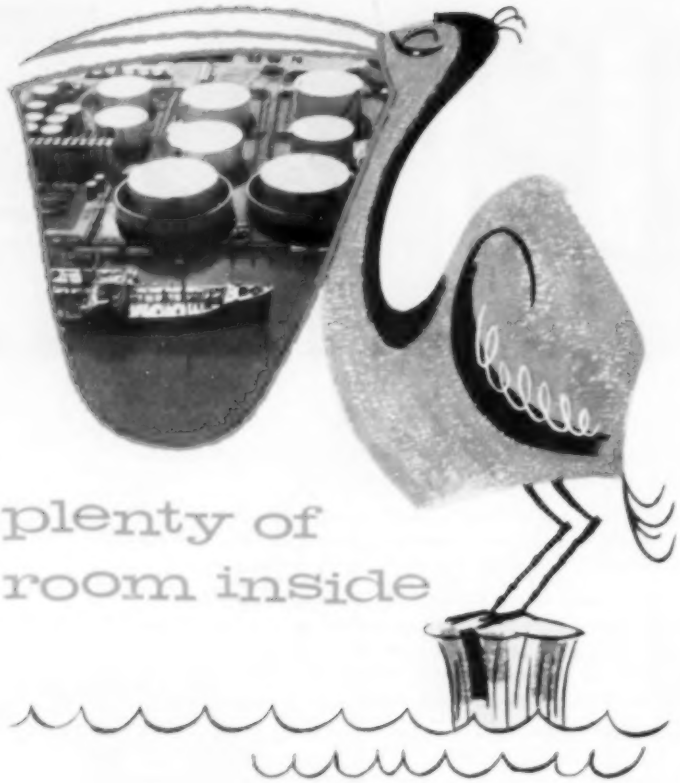
AND BIGELOW LIPTAK EXPORT CORPORATION
2550 WEST GRAND BOULEVARD, DETROIT 8, MICHIGAN

**UNIT-SUSPENDED WALLS AND ARCHES**

*In Canada:* BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MINNEAPOLIS • NEW YORK
PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

 *(To obtain more data on advertised products see page 1628)* 

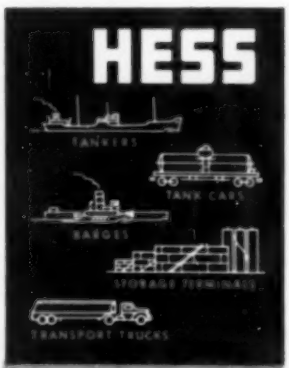



# 400,000,000 gallons of liquid storage capacity

If you buy, sell or use bulk liquid products, why not take advantage of the modern Hess storage terminals in New York Harbor or along the Gulf Coast. The key to more than 400,000,000 gallons of storage capacity is yours without capital investment . . . and Hess is geared to handle quantities from 10,000 to 10,000,000 gallons with complete tank and pipeline privacy.

Service when you want it—twenty four hours a day, seven days a week, plus tanker, barge, tank car, transport truck and high speed drumming facilities give you all the advantages of your own storage plant with none of the headaches.

You'll find the whole story in our new illustrated book "You can depend on HESS." Free copy on request. For fastest service, please call or write the Hess office nearest you.

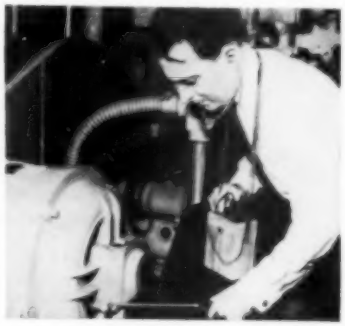



HESS, INCORPORATED
Perth Amboy, N. J.
VAlley 6-1000
HESS TERMINAL CORP.
Houston, Texas
Glendale 37195




cylinders. The action of these cylinders is controlled by servo valves. While one cylinder is delivering at a constant rate the second is being filled. The filling goes faster than the discharge so as to ensure smooth pump action. An electronic release activates the second cylinder into forward motion as the first cylinder nears the end of its stroke. An electronic interlock is activated when the pressure of the second cylinder is balanced with the discharge pressure in the first. The pump can be operated manually or automatically. A gear box allows selection of 40 different flow rates from 10 cc./hr to 600 cc./hr. The pump is enclosed in a metal cabinet 67 in. high, 22 in. wide, and 18 in. deep, with all controls on the front panel. Exline Engineering Co., 1636 East 6th St., Tulsa, Okla.

*Circle No.* **13** *on Reply Card*



## *Fault, Failure Detector*

**. . . for motors, piping leaks, or** surface flaws in many materials is the function of the "Auditec," a new portable electronic instrument. Such impending failures are said to be usually accompanied by audible warnings which because of their frequency, intensity, or surrounding noise, may not be heard by the unaided ear. The Auditec consists of a highly sensitive contact microphone encased in a probe handle, a three-stage amplifier, and plug-in headphones. Visual measurement can also be obtained by addition of an output meter. The unit, weighing 2½ lb., is powered by standard storage batteries. Probe microphones of various styles can be supplied for specific functions. John Ould (U. S. A.), Ltd., 519 South Fifth Ave., Mt. Vernon, N. Y.

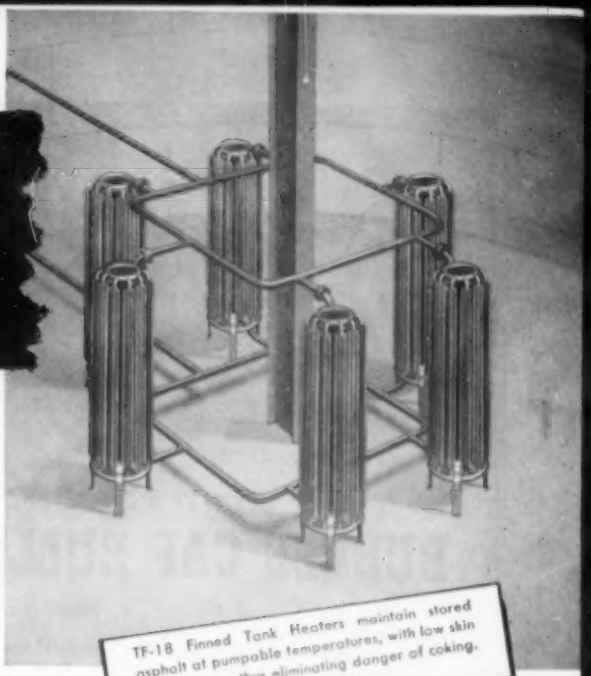
*Circle No.* **14** *on Reply Card*

## *Midget Water Still*

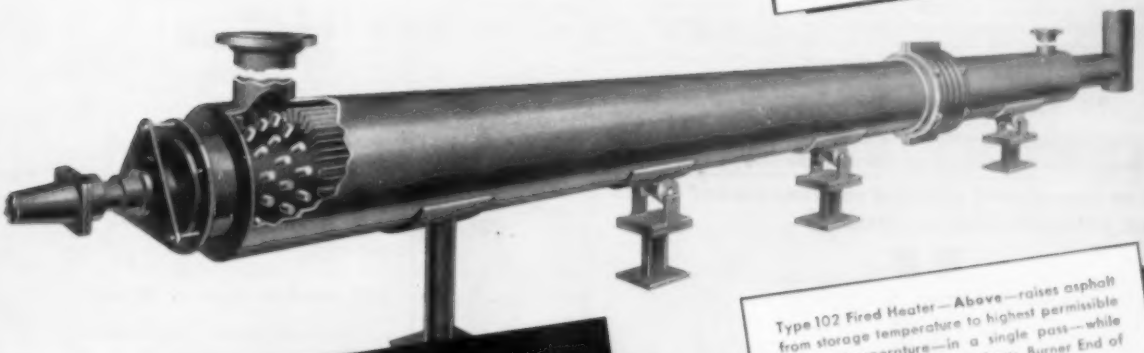
**. . . for small-volume users** is a portable laboratory model which will produce ½ gal./hr. Made of stainless steel and copper, with all critical sur-

# Asphalt plants

**load out faster**
**at higher temperatures...**
**serve a wider area...**



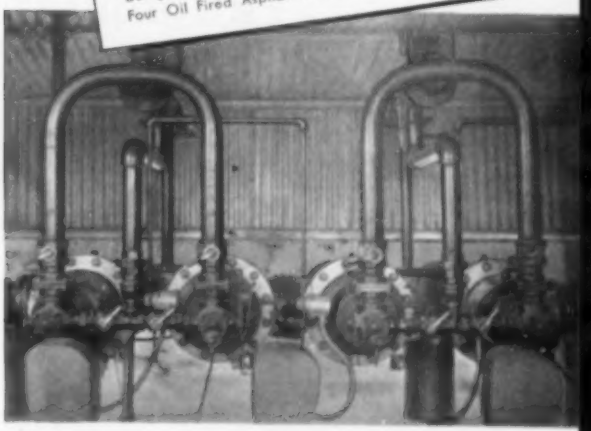
TF-18 Finned Tank Heaters maintain stored asphalt at pumpable temperatures, with low skin temperatures, thus eliminating danger of coking. Vertically mounted. Self cleaning.



Type 102 Fired Heater—**Above**—raises asphalt from storage temperature to highest permissible loading temperature—in a single pass—while being pumped to trucks. **Below:** Burner End of Four Oil Fired Asphalt Heaters.

**with Brown Fintube**

**TF 18 Tank Heaters and Type 102 Fired Heaters**



## BROWN FINTUBE COMPANY

*Elyria, Ohio*

***Engineering and Sales Representatives in the Principal Cities***

SEND FOR PSC

# BUBBLE CAP BULLETIN 22

*Largest Compilation of Engineering Data.*

*Lists 300 Styles Furnished Without Die Cost.*

This standard reference on bubble caps and risers contains complete specification information for hundreds of variations. Also many drawings for use in determining methods of tray assembly. With dies on hand for all listed styles, PSC can save you substantial die costs as well as design and delivery time. Furnished in any drawing type of metal, to meet your coking or corrosion problems. Assemblies will also be produced to your specifications.

THE PRESSED STEEL CO., 717 N. Penna. Ave., Wilkes-Barre, Pa.

**Custom Fabricators for the Process Industries Since 1928. Send Your Blue Prints.**

***for rapid and precise measurement of pressure and vacuum***

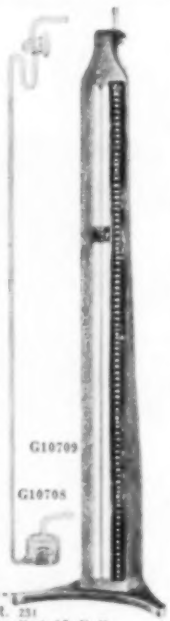
ABSOLUTE AND DIFFERENTIAL

# Manometers

**for industry · pilot plant and laboratory**

To cover the full range of pressure and vacuum measurements in the laboratory, pilot plant and industry, Emil Greiner offers its new Absolute and Differential Manometers. With these Manometers you can achieve either absolute or differential manometric measurements with unprecedented simplicity and high precision. Only a single reading is required to obtain a precise measurement automatically corrected for ambient temperature and reduced to a height of mercury at 0° C.

G10705A Range: 0-200 mm. (Glass only) ea. 29.50
G10705 Range: 0-200 mm. (with Stand) ea. 39.50
G10708 Range: 0-800 mm. (Glass only) ea. 39.50
G10709 Range: 0-800 mm. (with Stand) ea. 79.50




*For More Complete Information Write For "Constant Pressure and Vacuum Control Manual"*

The EMIL GREINER Co.
20-26 N. MOORE STREET DEPT. 23t N. Y. 13, N. Y.

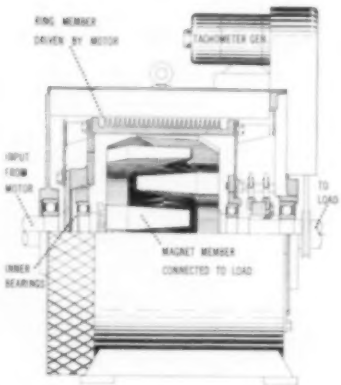
The Emil Greiner Co., Dept. 23t
20-26 N. Moore Street, New York 13, N. Y.
Please send me Instant Pressure & Vacuum Control Manual.

NAME_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE____ STATE_____




faces coated with black tin, the still is smaller than a 5-gallon carboy, and weighs 10 lbs. Condensing surfaces have wide areas, will not lime up or clog. There are no mechanical components, such as floats or valves. Rubber tubing provides adequate connection to water supply. The still can be disassembled in a matter of seconds for cleaning. An adjustable constant flow head device maintains water level regardless of changes in pressure, etc. An arrangement in the water inlet permits cooling the condenser while preheating inlet water for added efficiency of distillation. Precision Scientific Co., 3737 West Cortland St., Chicago 47, Ill.

*Circle No.* **15** *on Reply Card*




## Adjustable Speed Drive

**. . . has wide range of applications.** It can be coupled or belted to an existing motor to provide speed control of ±2% for fans, centrifugal pumps, and compressors. It is also designed to handle constant torque loads. The user can operate a load at optimum speed, change speed smoothly by manual means, or control it automatically. The system consists of (1) an "Ampli-Speed" drive installed between prime driver and load, (2) a wall-mounted magnetic amplifier speed control, and (3) a control rheostat mounted at any convenient location. The drive itself consists of a ring member connected to the input shaft and driven by the motor, and a magnet member on the output shaft which turns the load. There is no solid physical connection between the two members, although they are connected through two bearings. The ring member is driven at constant speed. The magnet member is excited by DC from the control The DC through the field winding sets up a magnetic attraction between the two members. Greater field excitation increases magnetic force between the

# ABC...and the Reader

BACK IN 1914—forty-one years ago—a group of advertisers, advertising agencies and publishers joined in a project that has come to mean a great deal to the millions who, like you, read business magazines. The project, initiated at a time when circulation claims were rarely verified, was intended to achieve and maintain higher standards of integrity in publishing and advertising practice by providing means to audit paid circulation. Out of that effort came an organization known as the Audit Bureau of Circulations, a voluntary, non-profit, cooperative association, known for short as ABC. Its symbol appears at the head of this page.

We are proud that McGraw-Hill publications were among the founders and charter members of the Audit Bureau of Circulations.

Today the Bureau numbers 3,670 members. These include advertisers, agencies, and publishers of newspapers, farm papers, general magazines and business journals such as this one. These publisher members hold their memberships and their right to display the ABC symbol in their publications only so long as they live up to the circulation standards that are established through the Bureau.

It is one thing to set up high standards; it is another to see that those standards are maintained. This latter and all-important function is performed by a staff of auditors maintained by ABC to check periodically on the circulation practices of the publisher members. When a business magazine, such as this one, joins the Bureau it agrees that the ABC auditors shall have "the right of access to all books and records." Their inspection may dig into the files of original subscription orders, payments from subscribers, paper purchases, postal receipts, arrears of payments, editorial expenses and many other significant items. Sometimes the auditors go behind the records and seek verification of purchase and payment from subscribers themselves.

The information thus obtained and certified by the Bureau then becomes available to the public and constitutes an authoritative report on the publication's circulation practices.

The advertisers and agencies benefit directly from the ABC because it provides a generally recognized factual yard-stick by which the circulations of member publications can be measured and appraised. Every paragraph in an ABC report on a business publication gives the advertisers data that help them make intelligent use of the publication as an advertising medium.

But the ABC renders a service of vital concern to the *reader* as well. The Bureau audits paid circulation only, and it is through this payment, whether by subscription or newsstand purchase, that the reader keeps the editorial policy of a publication responsive to his needs. His decision to buy or not to buy records his judgment on each publication, and the ABC-audited and certified circulation reports make the sum of these judgments known to all concerned.

So the editors of ABC publications must constantly keep their editorial services up to the mark if they are to survive a competition in which the reader's right to buy or not to buy is paramount. Each paid magazine or newspaper will prosper or fail as it wins or loses the voluntary patronage of thousands or millions of readers. And—the ABC is scorekeeper in this vital contest.

Thus the publisher who submits his publication to the supervision and discipline of ABC affirms in the strongest possible manner his recognition that his primary obligation is to his readers and that he owes the standing of his publication to a voluntary demand by those readers.

All this is what makes the ABC brand on a publication so important to its readers. That respected symbol, testifying to the advertising value of the publication, serves also as a constant reminder to all concerned that the reader's willingness to pay for an ABC publication is the basic reason why it stays in business.

*McGraw-Hill Publishing Company, Inc.*

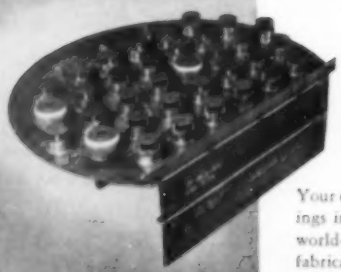
# GLITSCH

**BUBBLE CAPS...**

**ANY SHAPE**
**ANY SIZE . . .**

Existing dies of 287 different cap and riser designs, as well as data on various ratios of related areas, are available to your engineers during planning stages. Practical ideas for improvements to keep apace constantly changing petroleum refining and chemical processing are a GLITSCH service of world-wide proportions.

**GLITSCH "TRUSS-TYPE" TRAYS**



Lightweight, simple, adaptable with complete freedom of layout, GLITSCH "Truss-Type" mechanical design is not restricted to standardized patterns. You specify your process requirements.

Your engineering staff can effect definite savings in initial designing through GLITSCH world-wide experience in plans, design and fabrication of tower internals.

Cost analyses of tower internal equipment for fabrication in a wide range of material are available promptly.

*Glitsch*
FRITZ W. GLITSCH & SONS, INC.
P. O. Box 6227
DALLAS 2, TEXAS

SALES OFFICES: New York · Chicago · Cleveland · Houston · Tulsa · Los Angeles



## Are You Moving?

Please let us know as soon as you can so we can change your subscription stencil addressing plate. Be sure to send us

(1) Your *old* address (including company connection)

(2) Your *new* address (including company connection)

(3) The *date* the change becomes effective

PETROLEUM PROCESSING—Subscription Department
330 West 42nd Street—New York 36, N. Y.




two, so that the magnet member's speed increases. The controller adjusts speed by controlling output of a metallic rectifier supplying the field excitation. The new drive is designed for use with motor speeds of 870, 1150, and 1750 rpm. Hp ratings of the two available sizes range up to 95 for fan type loads. For constant torque loads, output ranges up to 75 hp., depending upon input speed and required speed range. Electric Machinery Mfg. Co., Minneapolis 13, Minn.

*Circle No.* **16** *on Reply Card*

### *Acrolein Derivative*

. . . **1, 5 Pentanediol,** is now available in tank car, tank truck, and drum car load quantities from the manufacturer. This new diol undergoes reactions typical of glycols—oxidation, dehydration, esterification, and acetalization. It forms esters and polyesters which are important intermediates in the manufacture of polyester resins, urethane foams and elastomers, fibrous glass-reinforcing resins, and so on. It is also of interest to makers of lube oil additives, resin solvents, brake and hydraulic fluid compositions, antifreeze solutions, and chemical intermediates. Carbide & Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.

*Circle No.* **17** *on Reply Card*

### *New Direct Viscometer*

. . . **determines kinematic viscosity** in a matter of minutes, for fuels, light oils, and non-corrosive liquids. Flow system design makes possible readability with 1% of indicated viscosity at any point of the scale. Ranges of the Type II instrument are 0.5 to 5.0 and 3.0 to 30 centistokes. It is supplied as a portable unit for the laboratory or for the field, or as a panel-mounted instrument for use on either new or existing test equipment. Its maximum weight of 8 lb. includes thermometer, filter, filter cartridge, and AN outlet fittings. Commercial Research Laboratories, Inc., 20 Bartlett Ave., Detroit 3, Mich.

*Circle No.* **18** *on Reply Card*

## Free Trade Literature

### *Regular Controls*

. . . of the high and low pressure balanced valve types: 36-page *Bulletin No. 1094* gives complete descriptions, specifications, applications, etc. Rock-

DOW

You Can See Why

# SARAN LINED PIPE

## CUTS CORROSION COSTS

**Corrosion resistant Saran Pipe swaged into steel is your answer to downtime losses.**

Saran lined pipe, fittings and valves are built to convey acids, alkalies and other corrosive liquids at low over-all costs. The durable inner lining eliminates shutdowns due to corrosion and forms snug, tight-fitting joints that prevent leakage.

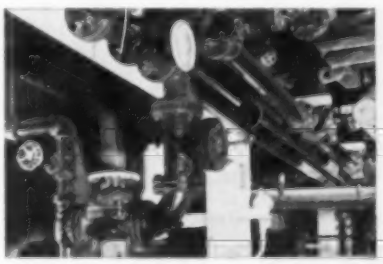
Saran lined pipes, fittings, and valves are easily and inexpensively installed. They are cut and threaded in the field with any standard pipe fitter's tools. Because of saran lined pipe's rigidity, even long spans require a minimum of support.

If your operation requires the conveying of corrosive liquids, and if downtime losses are troubling you, investigate saran lined pipe, fittings, and valves today. For further information, contact the Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale 20, Mich. Dept. 526F-1

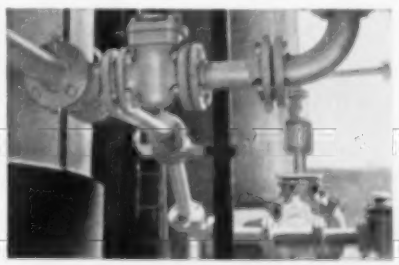
RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

SOME OF THE MANY
INSTALLATIONS USING
**SARAN LINED**
STEEL PIPE

*Saran Lined Pipe is Manufactured by The Dow Chemical Company Midland, Michigan*



A large chemical company uses this installation to convey demineralized water. It has a perfect record of keeping the water free of contamination for five years!



Saran lined pipe used for conveying hydrochloric acid at temperatures from 20° to 90°C., has had no unscheduled interruptions due to corrosion for over two years!

*you can depend on DOW PLASTICS* DOW

How can I reduce tube cleaning down-time ?

...with AIRETOOL tube cleaners!

**SUBTRACT costly downtime**

Coke and clogged tubes eat a big hole in a cost control sheet. It's natural then, that more and more refineries are coming to rely on the realistic savings Airetool tube maintenance equipment adds.

Take the Airetool "6000" series of cleaners for example. In matter of minutes (not hours), they whisk away profit-stealing deposits from tubes that slow up your production.

Airetool ball-bearing motor with single expansion cutter head for cleaning straight tubes. Motor is slip-fit constructed, and has front and rear ball-bearing thrusts.

**MULTIPLY precious profit**

Reliable reports from many make this a fact.

Maybe you want to subtract some of that costly downtime from your tube maintenance jobs — by adding the advantages of Airetool.

We'd be happy to prove our point on the toughest tube assignment you can come up with. Write us direct — or if you prefer — call in the Airetool representative nearest you.

*"There's an Airetool Tube Cleaner and Tube Expander for Every Type of Tubular Construction."*

**AIRETOOL**
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Philadelphia, Houston, Tulsa, Baton Rouge. Representatives in principal cities of U.S.A., Canada, Mexico, South America, England, Puerto Rico, Hawaii, Japan, Italy
EUROPEAN PLANT: Airetool Nederland N.V., Vlaardingen, The Netherlands




well Manufacturing Co., Meter and Valve Div., 400 Lexington Ave., Pittsburgh 8, Pa.

*Circle No.* **19** *on Reply Card*

### New Tower Packing

. . . for distillation, absorption, fume scrubbing, etc.: Bulletin *Spraypak* describes construction, performance and mechanical design. Fractionating Towers, Inc., 5711 Boulevard East, West New York, N. J.

*Circle No.* **20** *on Reply Card*

### Air Pollution Control

. . . using activated carbon: *Bulletin E-21* describes types of atmospheric contaminants and treatments to eliminate or reduce contaminants in industrial exhaust gases. Barneby-Cheney Co., Cassady at E 8th Ave., Columbus, Ohio.

*Circle No.* **21** *on Reply Card*

### New Control Valve

. . . of the diaphragm type: *Specification Sheet 429* describes the "Series 400", gives specifications, flow characteristics and dimensions for the double-seated, single-seated, and three-way types available. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

*Circle No.* **22** *on Reply Card*

### Radiochemicals

. . . for industrial research: 24-page booklet tells what radiochemicals are and how they are used, and lists more than 130 organic and inorganic radiochemicals including carbon-14 labeled compounds and deuterated compounds. General Chemical Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.

*Circle No.* **23** *on Reply Card*

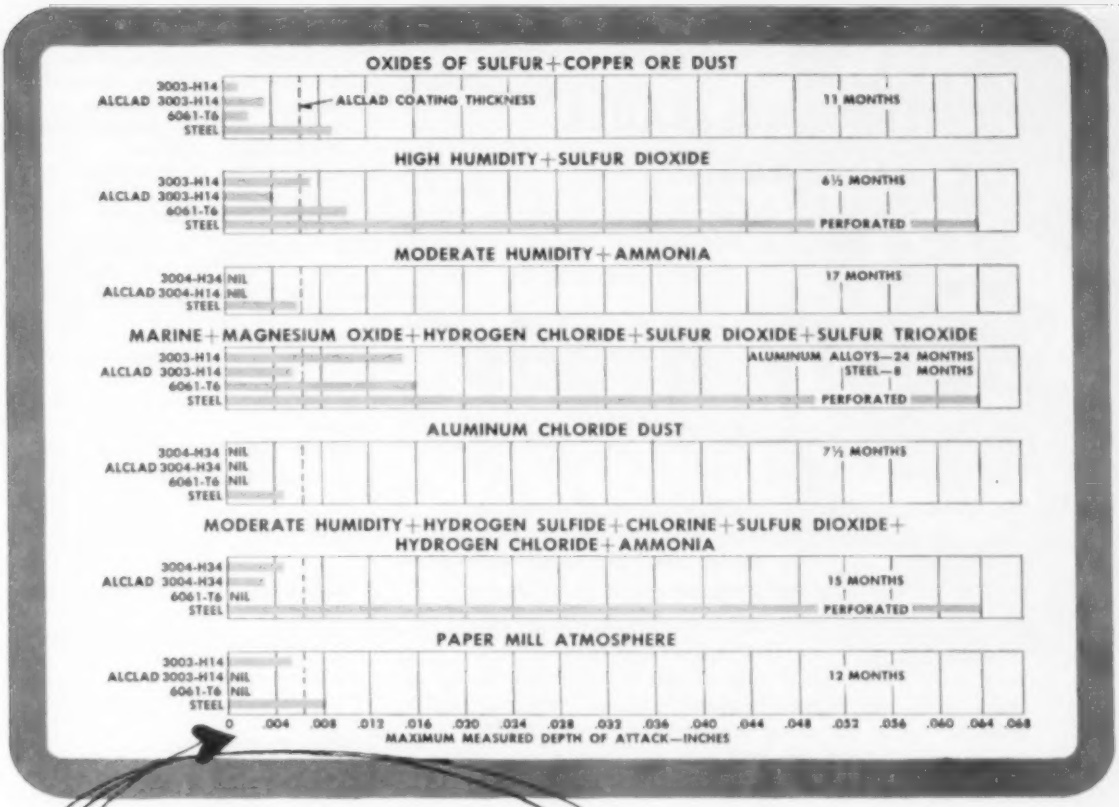
### Gasoline Leading

. . . by automatic proportioning and blending: *Reprint SM-2000-2*, "Continuous, Automatic Loss-in-Weight Proportioning and Blending of Tetraethyl Lead to Gasoline," discusses gravimetric proportioning equipment and methods. Proportioneers, Inc., 345 Harris Ave., Providence, R. I.

*Circle No.* **24** *on Reply Card*

### Proximity Measurement

. . . of process variables without touching the specimen: 28-page *Manual TM-951-1* describes the electronic capacitance instrument for measuring


OXIDES OF SULFUR + COPPER ORE DUST
3003-H14
ALCLAD 3003-H14
6061-T6
STEEL
ALCLAD COATING THICKNESS
11 MONTHS
HIGH HUMIDITY + SULFUR DIOXIDE
6½ MONTHS
PERFORATED
MODERATE HUMIDITY + AMMONIA
3004-H34 NIL
ALCLAD 3004-H14 NIL
17 MONTHS
MARINE + MAGNESIUM OXIDE + HYDROGEN CHLORIDE + SULFUR DIOXIDE + SULFUR TRIOXIDE
ALUMINUM ALLOYS—24 MONTHS
STEEL—8 MONTHS
ALUMINUM CHLORIDE DUST
7½ MONTHS
MODERATE HUMIDITY + HYDROGEN SULFIDE + CHLORINE + SULFUR DIOXIDE + HYDROGEN CHLORIDE + AMMONIA
15 MONTHS
PAPER MILL ATMOSPHERE
12 MONTHS
0 .004 .008 .012 .016 .020 .024 .028 .032 .036 .040 .044 .048 .052 .056 .060 .064 .068
MAXIMUM MEASURED DEPTH OF ATTACK—INCHES

# *This exposure test proves ALCOA Aluminum resists refinery atmospheres*

## Resistance of ALCOA Aluminum alloys to certain atmospheric contaminants, compared with steel

Data for this chart were collected in various chemical plants. Bars indicate maximum measured depth of attack, in inches. Duration of exposure test is indicated on chart.

The most important property ALCOA Aluminum has to offer to the chemical and process industries is its high resistance to corrosion. Significant savings based on longer life, reduced maintenance and less down time are a direct result of the intelligent use of ALCOA Aluminum in these industries.

For example, aluminum alloys have been used for many years for process equipment by the ammonium nitrate industry, but only recently has the economy of the use of structural aluminum been recognized. It is becoming standard to specify aluminum structurals, grating, tread plate, conduit, electrical fittings, etc., in plants handling ammonium nitrate as well as other chemicals.

ALCOA's coordinated research and development program is geared to help you with *your* specific problems . . . to show you where and how aluminum can be used most effectively in your operations. Write today for details.

Investigate ALCOA Aluminum today. Get all the facts. They're in the new, FREE double reprint, *Resistance of Aluminum Alloys to Weathering* and *Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres*. Use the coupon at right to obtain your copy. We also have a new booklet, *Aluminum Pipe and Fittings*. Send for it.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Aluminum Company of America
1000-K Alcoa Building
Pittsburgh 19, Pennsylvania

Please send me your new, FREE reprint, *Resistance of Aluminum Alloys to Weathering* and *Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres*. Also, *Aluminum Pipe and Fittings*.

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

 *(To obtain more data on advertised products see page 1628)* 

PIONEER AND LEADER
FOR 25 YEARS...

# BS&B Safety Heads

## THE "CIRCUIT-BREAKER" OF PRESSURED SYSTEMS

The introduction of the BS&B Safety Head some 25 years ago presented industry with an entirely new type of precision safety device designed to protect equipment wherever overpressure was a problem.

Down through the years many special and improved models of BS&B Safety Heads and rupture discs have been developed to take care of specialized applications. Thousands upon thousands of them are "on-the-job" today guarding pressured systems in virtually every type of industry.

From our stock of thin ductile metals (which is the widest assortment in the world assembled in any one place) we can fabricate over 95% of all rupture disc orders from materials on hand.

Typical Industries Which Use BS&B Safety Heads:

Chemical Processing
Oil & Gas Production, Pipeline and Refining
Power Generation
Food Processing
Air Conditioning and Refrigeration
Transportation
Paper Mills
General Manufacturing

BLACK, SIVALLS & BRYSON, INC.

Safety Head Division, Dept. 2-DIO
7500 East 12th Street
Kansas City 26, Missouri




temperature, vibrations, pressure, moisture content, etc. Robertshaw-Fulton Controls Co., Fielden Instrument Div., 2920 N. 4th St., Philadelphia 33, Pa.

*Circle No.* **25** *on Reply Card*

### Drum Specifications

. . . for shipping dangerous, liquid and solid products: the three specifications are for 55-gal. drums conforming to Inter-State Commerce Commission regulations 5B, 17C and 17H. Steel Shipping Container Institute, 600 Fifth Ave., New York 20, N. Y.

*Circle No.* **26** *on Reply Card*

### High Vacuum Pumps

. . . from ¼ to 40 hp.: 52-page *Catalog No. 425* describes compound single-stage simplex, single-stage duplex and two-stage mechanical booster high vacuum pumps, and presents engineering data in the form of conversion tables, charts, formulae, etc. New York Air Brake Co., Kinney Manufacturing Div., 3640 Washington St., Boston 30, Mass.

*Circle No.* **27** *on Reply Card*

### Fire Protection

. . . by equipment using "Foamite Airfoam": 34-page *Catalog AD 17004-10M-V-5/55* contains engineering data and facts on fixed, semi-portable and portable fire extinguishing systems for fighting tankage fires. American La-France Corp., Elmira, N. Y.

*Circle No.* **28** *on Reply Card*

### Feed Preparation

. . . for use in processes with platinum catalysts: 12-page technical study discusses removal of arsenic, lead, sulfur and nitrogen compounds with clay, covers processing schemes, plant designs, and clay description and costs. Minerals & Chemicals Corp. of America, 210 W. Washington Square, Philadelphia 5, Pa.

*Circle No.* **29** *on Reply Card*

### Ductile Nickel Irons

. . . combining strength, ductility and resistance to corrosion, heat and metal-to-metal wear: bulletin on *Nickel Austenitic Ductile Irons* compares properties of conventional and ductile "Ni-Resist" irons and summarizes present and potential applications. The International Nickel Co., Inc., Reader Service Section, New York 5, N. Y.

*Circle No.* **30** *on Reply Card*

### Electric Operated Valves

. . . for the remote control actuation of valves: 38-page bulletin describes

solenoid operated valves, relay valves and electro-hydraulic valve actuators, also contains specifications, design formulae and engineering charts. Electro-Hydraulics Ltd., Technical Publications Dept., Liverpool Rd., Warrington, England.

*Circle No.* **31** *on Reply Card*

### Vacuum Melted Metals

. . . for pure, consistent compositions: 23 page bulletin *VM-101* covers effects of vacuum melting on properties of various metallic materials and benefits of the process to the user, includes fabricating and machining recommendations and detailed engineering data on two vacuum melted high temperature alloys now in commercial production. General Electric Co., Carboloy Dept., Detroit 32, Mich.

*Circle No.* **32** *on Reply Card*

### Temperature Instruments

. . . of the filled thermal type for indicating, recording, controlling, transmitting, compensating, and programming temperatures from —400 to +1000° F.: 24-page *Catalogue 12-A-10* describes the line of vapor-filled systems recently added by the company, and discusses sensitive bulbs, unit-connected bulb assemblies, bushings, etc. Fischer & Porter Co., Hatboro, Pa.

*Circle No.* **33** *on Reply Card*

### High Pressure Equipment

. . . for the process industries: 25-page *Catalogue No. 2055* describes high pressure valves, adapters, reactors, autoclaves, thermo-couplings, gages, fittings and tubing. High Pressure Equipment Co., Inc., 1222 Linden Ave., Erie, Pa.

*Circle No.* **34** *on Reply Card*

### Engineering Services

. . . for the process and other industries: 31 page bulletin *Kaiser Engineers* describes construction facilities and services to the chemical and other process industries. Kaiser Engineers, Div. of Henry J. Kaiser Co., Kaiser Bldg., Oakland, Calif.

*Circle No.* **35** *on Reply Card*

### Propeller Fans

. . . for industrial applications on heating and cooling equipment: 39-page *Catalogue A-109A* gives specifications, dimensions, and performance figures on 20 different types of industrial ventilating fans. Hartzell Propeller Fan Co., Piqua, Ohio.

*Circle No.* **36** *on Reply Card*

### Line Metering

. . . for liquid, steam, air, or gas through the utilization of a Venturi insert nozzle: *Bulletin 130-K3A* describes the specially lined throat with annular chamber and multiple vent

Here is a new line of Sight Flow Indicators . . . easily and inexpensively installed in any new or existing pipe line ½" to 2" N.P.T.

The special design of these new indicators results in a turbulence in the flow of liquid, making it easily visible. Several types of indicating vanes, installed within the chamber, may also be furnished, according to variable conditions of rate of flow and viscosity of liquid. For indication of minute flows, small Sight Flow Indicators with a rotating vertical rising ball are available.

Jerguson Sight Flow Indicators are soundly designed, carefully made, and are backed up by a company with over 40 years experience in the field. Available in Transparent and Reflex types, in a wide variety of materials and linings, and with Wedge Type Illuminators, Haveg Chambers, Non-Frosting Glasses, or other special construction.

*If you have a problem of viewing the flow of liquid in a pipe line, it will pay you to investigate the new Jerguson Sight Flow Indicators today. Send us your requirements or write for Data Unit.*

JERGUSON

*Gages and Valves for the Observation of Liquids and Levels*

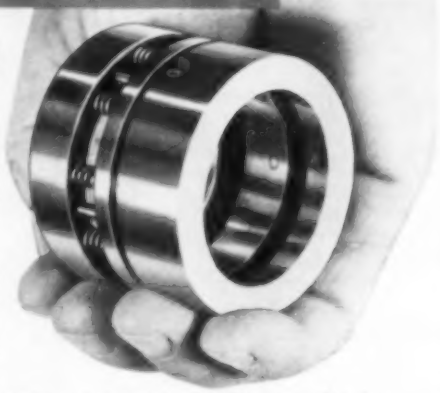
JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
*Offices in Major Cities*
Jerguson Trees Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

# The Answer to Your SEALING PROBLEMS in the Palm of Your Hand

DURA SEAL

. . . an engineered rotary mechanical seal that is made to meet YOUR SPECIFIC SEALING NEED using selected alloys, carbons and ceramics.

In general, Dura Seals can be installed on new or existing equipment—no sleeves or special machining necessary.



*Write Today* FOR DETAILS — ASK FOR BULLETIN NO. 455-PP

Send your sealing problems to us for free counsel

The PERFECT SEAL

DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN

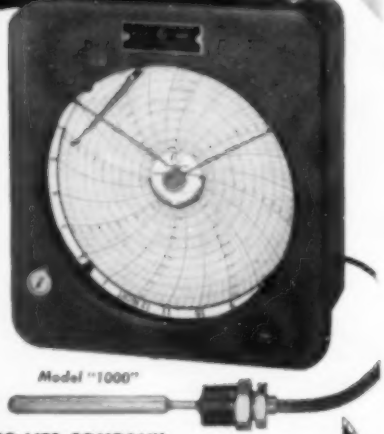


# AUTO-LITE

## TEMPERATURE RECORDING...

Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from $49.50.

*Send for new catalog describing many styles of Auto-Lite temperature Recorders and Indicators.*



Model "1000"

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS




giving high pressure head recovery and rentention of initial accuracy, as well as low-head loss, easy installation, and low maintenance. Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.

*Circle No.* **37** *on Reply Card*

### Chilling Equipment

. . . for the shrink-fit assembly of metal parts, metal treatment through chilling, gas dehydration and metal and material testing: 12-page *Bulletin 102 (Rev.)—10M-Z-5-55* illustrates seven chilling machine models and four industrial temperature testing unit models, giving specifications, complete descriptions, and technical data on applications. Cincinnati Sub-Zero Products, Reading Rd. at Paddock, Cincinnati 29, Ohio.

*Circle No.* **38** *on Reply Card*

### Infrared Analyzer

. . . for industrial process gases: *Data Sheet ND46-9I(1)* describes the analyzer and its housings, provides brief facts about installation, operation and maintenance of the equipment, and describes the single cell column construction with elimination of need for lenses, mirrors and moving parts. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

*Circle No.* **39** *on Reply Card*

### Oil-Hydraulic Pumps

. . . for general industrial applications: 56-page *Catalogue No. 5001A* describes the pumps, controls and accessories, including engineering, design and application information, pressure controls, volume controls, directional controls, control assemblies, hydraulic motors, transmissions, etc. Vickers, Inc., 1400 Oakman Blvd., Detroit 32, Mich.

*Circle No.* **40** *on Reply Card*

### Laminated Teflon Pipe

. . . for corrosive applications: *Bulletin FTL-1* describes the physical and chemical properties of "Fluoroflex-T" laminated pipe made of woven glass impregnated with Teflon resin, giving data on piping specifications, coupling methods, and suggested applications. Resistoflex Corp., 39 Plansoen St., Belleville, N. J.

*Circle No.* **41** *on Reply Card*

### Process Automation

. . . for the petroleum and chemical industries: *Kelloggram, Issue No. 3, 1955 Series*, discusses the concepts of

## Tight, easy valve closure every time after 4 years on 800° F. oil

THE CASE HISTORY—With no maintenance whatsoever in more than 4 years' continuous service, these Crane 300-pound steel gates show no loss of efficiency. Fact is, they look good for service indefinitely.

The installation is at Cities Service Oil Co.'s Ponca City refinery. The valves are on the hot oil outlet lines from a crude unit heater. Oil handled is 800° F.

While operated fairly frequently under high temperature, these Crane No. 33X valves show no effects from this severe service. They have provided tight closure with no leakage at any time—and with unfailingly smooth response to the handwheel.

Outwardly Crane steel valves may look like many others. But there's a big difference inside. For instance, in the extra skill and care that go into Crane Exelloy seating design and manufacture.

That's what makes these Crane valves such outstanding performers in refinery service.

In steel gates, globes, angles and checks, Crane gives complete selection—in sizes up to 24 inches—in pressure classes up to 2500 pounds. See your local Crane Representative for valuable help in specifying and ordering.

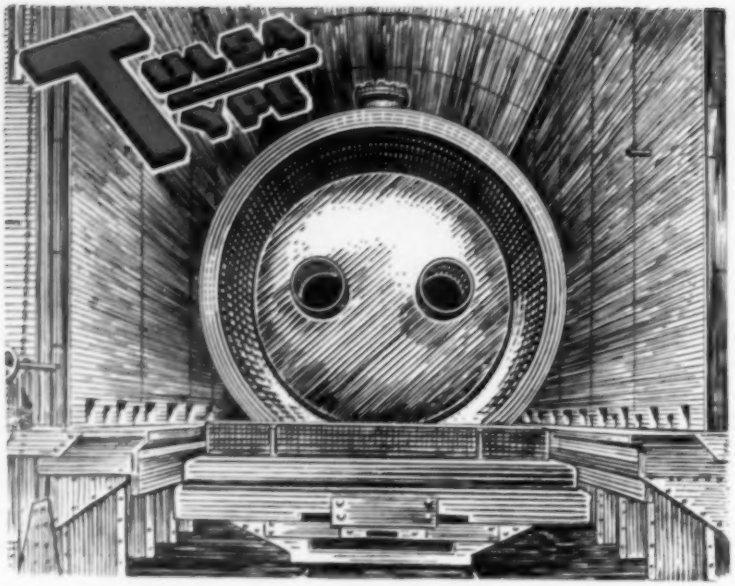
Crane Co., General Offices, Chicago 5, Ill. Branches and Wholesalers in all areas.

# CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

 *(To obtain more data on advertised products see page 1628)* 




## TURKISH BATH for TIRED TOWERS

Steel plate suffers from stress and strain, even as you and I. So, FLINT STEEL puts completed units through a stress-relieving treatment, in this giant 85-foot long, car-type bake oven. Heated up to a minimum of 1100 degrees Fahrenheit, the molecules in these steel plates "relax", and the stress-free tower which emerges will be stronger — more durable. Just one more example of the careful engineering and processing which go into each piece of TULSA TYPE equipment made only by FLINT STEEL CORPORATION.

BUILT Right

*Write for our General Catalog*

**FLINT STEEL CORPORATION**
TULSA, OKLAHOMA

Join the Successful men who profit from Platt's OILGRAM News Service

*Complete DAILY News from the World's Leading Oil Centers*

Profit by reading Platt's OILGRAM News Service every morning. Days, often weeks ahead of other oil industry news sources. Brief, accurate, quotable. Delivered to your desk by fastest mail every morning Monday through Friday.

*For further information and sample copies, just write us on your regular business letterhead.*

Platt's OILGRAM News Service, McGraw-Hill Publishing Co., 330 W. 42nd St., N. Y. 36, N. Y.



automation, gives diagrams to illustrate the basic functions of instruments used in automatic control such as radio-isotopes, discusses data reduction systems, electronic instrumentation, stream analyzers and high pressure instruments. The M. W. Kellogg Co., 225 Broadway, New York 7, N. Y.

*Circle No.* **42** *on Reply Card*

### Electron Microscope

. . . question and answer booklet on operations and applications, explaining such items as shadow castings, use of the same instrument for electron diffraction, resolution, visual and camera work, specimen preparation, negative and positive replicas and electron and lens theory. Research and Control Instruments Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y.

*Circle No.* **43** *on Reply Card*

### Plug Valve

. . . of the non-lubricated type with double sealing surfaces for vaportight cutoff: bulletin on *Twin Seal Valves* gives a detailed story of the valve, a price list, complete dimensional data, and a listing of features and applications. Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh 22, Pa.

*Circle No.* **44** *on Reply Card*

### Speed Reducers

. . . of the straight line and right angle type for industrial equipment: 39-page *Engineering Manual LP No. 3* describes the "Line-O-Power," its advantages, features, construction, adaptability, applications, and factors such as load characteristics, efficiency, etc., and dimensional and rating tables. Foote Bros. Gear & Machine Corp., 4545 S. Western Blvd., Chicago 9, Ill.

*Circle No.* **45** *on Reply Card*

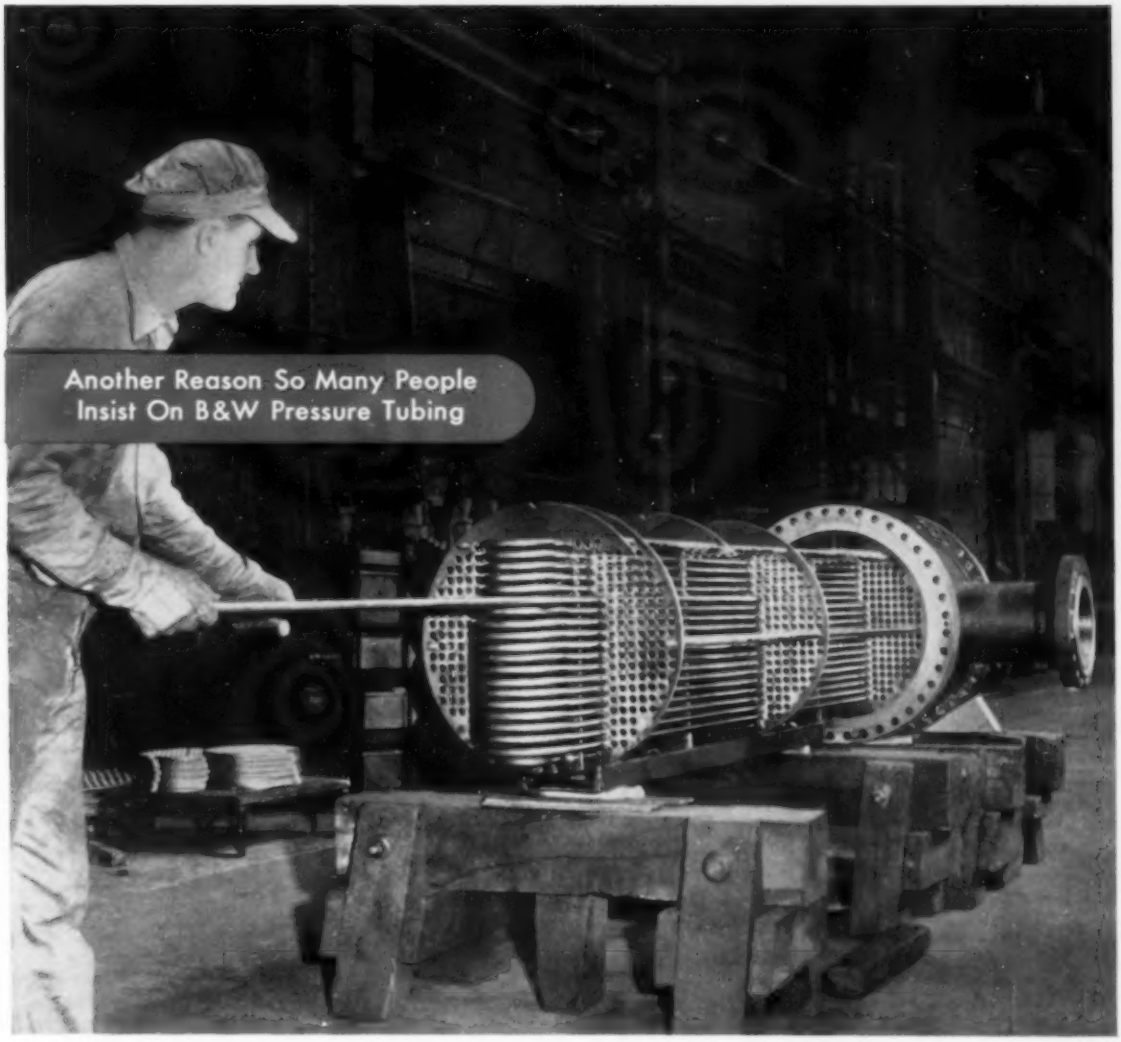
### Lithium

. . . and its growth from an almost obscure chemical element into a multimillion dollar business: *Foote Prints, Vol. 27, No. 1, 1955* discusses the industrial growth of lithium production and its possible position in tomorrow's market as a possible rival of uranium for isotopes. Foote Mineral Co., 18 W. Chelton Ave., Philadelphia 44, Pa.

*Circle No.* **46** *on Reply Card*

### Precipitators

. . . primarily for use in water softening, reduction of alkalinity and the removal of turbidity, color, taste, odor, silica and fluoride: 20-page *Bul-*




# TALK ABOUT TOLERANCES!!

In oil fields, refineries, chemical plants—wherever heat transfer is important—you'll find Griscom-Russell heat exchangers on the job. The Griscom-Russell Company uses B&W Pressure Tubing to help build its reputation for efficient equipment. There's no jamming or tube distortion when threading B&W tubing through tube sheets and baffle plates. This preoccupation with close tolerances—a workaday rule at both B&W and Griscom-Russell—assures closer control, greater efficiency in many heat transfer operations. In addition, B&W Pressure Tubing is famous for uniform ductility, tight joints, ease of rolling in, and low installation cost in any heat exchanger or condenser application.

For the complete story of how B&W Pressure Tubing can improve your operation, why not call in Mr. Tubes, your link to B&W. *Or write today for Bulletin TB-329-pp.*

B&W
TUBULAR PRODUCTS DIVISION

**THE BABCOCK & WILCOX COMPANY**
***TUBULAR PRODUCTS DIVISION***
Beaver Falls, Pa. and Milwaukee, Wis. Seamless Tubing.
Welded Stainless Steel Tubing
Alliance, Ohio Welded Carbon Steel Tubing
Milwaukee, Wis. Seamless Welding Fittings

TA-5022(P)

# NEW
## Arnold O. Beckman
MODEL F3
OXYGEN ANALYZER

*with the meter on the door*

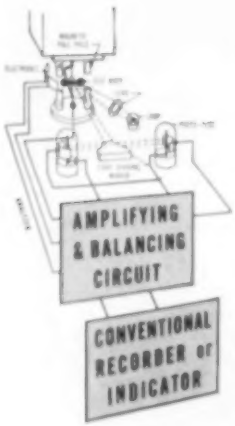
*New convenience has been built into the well-known F3 Oxygen Analyzer . . . a meter on the door provides readings at the sampling point for making calibration checks, process changes, etc. In fact, complete analyzing, calibrating and indicating components are now incorporated into the single F3 unit—at no extra cost!*

**Use The Model F3**

**ON OPERATIONS LIKE THESE . . . TO MAKE SAVINGS LIKE THESE**

| | |
|---|---|
| **COMBUSTION**<br>Boilers, Kilns, Direct-Fired Heaters, Stills, etc. | *Higher combustion efficiencies at lower fuel costs* |
| **PROCESSING**<br>Air Liquifraction . . . Processing Butadiene, Acetylene and Similar Gases | *Better product quality with minimum oxygen or air contamination* |
| **PLANT SAFETY**<br>Hydrogenation, Hydrofining, Gas Compressors, Sulfur Grinding, etc. | *Control explosive atmospheres, reduce fire risks, minimize plant and personnel hazards* |

## Unique Operating Principle




The various applications highlighted above are only a few of the many ways Arnold O. Beckman Oxygen Analyzers—industry's great new profit builders—are being used by progressive operators to boost profits, cut costs.

These are the *only* oxygen analyzers that *continuously* measure process streams by an advanced magnetic principle that provides *direct physical measurement of the oxygen itself*—not of some secondary relationship.

Heart of the unit, as illustrated, is a dumbbell-shaped test body suspended in a magnetic field. Sample gas surrounding this test body causes it to rotate in the field, depending upon the oxygen content of the gas. The movement of a light beam, reflected by a small mirror on the test body, is measured by simple electronic circuits . . . and the result indicated directly on a conventional recorder or indicator. It's simple, positive, accurate!

*No chemicals—filaments—catalysts cams—complicated mechanical parts!*

**FEATURES OF THE F3**

**Many Ranges:** Full scale ranges of 0-5%, 0-10%, 0-15% $O_2$ and higher.

**Accuracy:** 1% of full scale.

**Multi-Ranges:** Any instrument may be supplied with two or more ranges.

*Note: For ranges narrower than 0-5% $O_2$ ask about the Model G2.*

**Send for Helpful Free Literature** *which describes this unique operating principle in detail—explains its many advantages and applications. When writing, outline your particular operations—we'll gladly supply specific information.*

**Ask For Data File 16J-105**

Arnold O. Beckman INC
*Instruments for Science and Industry*
1020 MISSION STREET
SOUTH PASADENA, CALIFORNIA




*letin No. 2204C* describes applications, operation principles, design features, advantages, recommendations, flow diagrams, and specifications. The Permutit Co., 330 W. 42nd St., New York 36, N. Y.

*Circle No.* **47** *on Reply Card*

### Heat Transfer Covering

. . . eliminates the need for steam jacketing or thermal electric systems, on equipment handling materials becoming viscous or solidified at normal temperature: bulletin on *Thermon* describes applications, use and heat transfer properties of the non-metallic plastic compound which is applied as a coat over equipment or piping surfaces in conjunction with steam tracing lines to insure even heating of the equipment surfaces. Thermon Mfg. Co., 1017 Rosine St., P. O. Box 1961, Houston, Tex.

*Circle No.* **48** *on Reply Card*

### Ultrasonic Gage

. . . for measuring thicknesses instantly from one side of the material under test: *Bulletin No. V-101* describes the "Vidigage," its operating principles, typical applications, and features. Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn.

*Circle No.* **49** *on Reply Card*

### Stainless Tubing and Pipe

. . . of the seamless type: *Bulletin TB-355* contains information for engineers and designers including the attributes of stainless steel and how it can be fabricated, tables of analyses, mechanical properties, creep strength, physical properties and oxidation resistance of nine of the most popular stainless tubing steels. Tubular Products Div., The Babcock & Wilcox Co., Beaver Falls, Pa.

*Circle No.* **50** *on Reply Card*

### Steam Generation

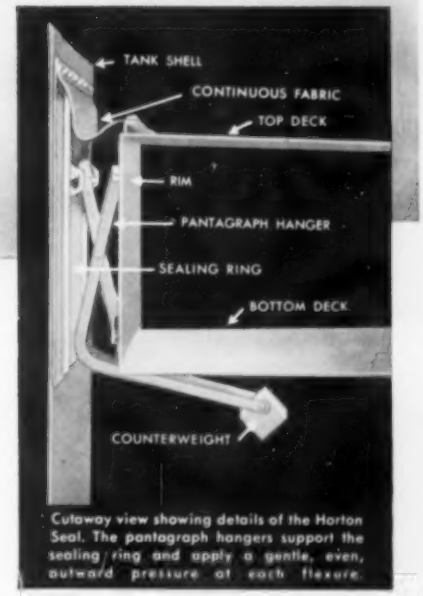
. . . equipment and water tube boilers: 10-page bulletin describes and illustrates various types of water tube boilers and auxiliaries including water-cooled furnaces, superheaters, economizers, air preheaters, and steam washers, as well as containing diagrams, tables, and boiler data. Edge Moor Iron Works, Inc., Hoboken, N. J.

*Circle No.* **51** *on Reply Card*

### Fume Scrubbers

. . . for pollution control, employing water or other suitable liquids as the scrubbing agent to control fumes or

# A Horton Seal paying its way...




Cutaway view showing details of the Horton Seal. The pantagraph hangers support the sealing ring and apply a gentle, even, outward pressure at each flexure.

This Horton® Seal is part of a Horton Double-Deck Floating Roof installed in a 64,000-bbl. gasoline storage tank at a large western refinery. Standard equipment on all Horton Floating Roofs, the Horton Seal pays its way by preventing the evaporation of volatile hydrocarbons between the rim of the roof and the tank shell. When the Horton Seal is installed on a tank, no secondary seal is required.

Write our nearest office for further information concerning Horton Floating Roofs.

**Chicago Bridge & Iron Company**

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa
*Plants in* BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.


*(To obtain more data on advertised products see page 1628)*

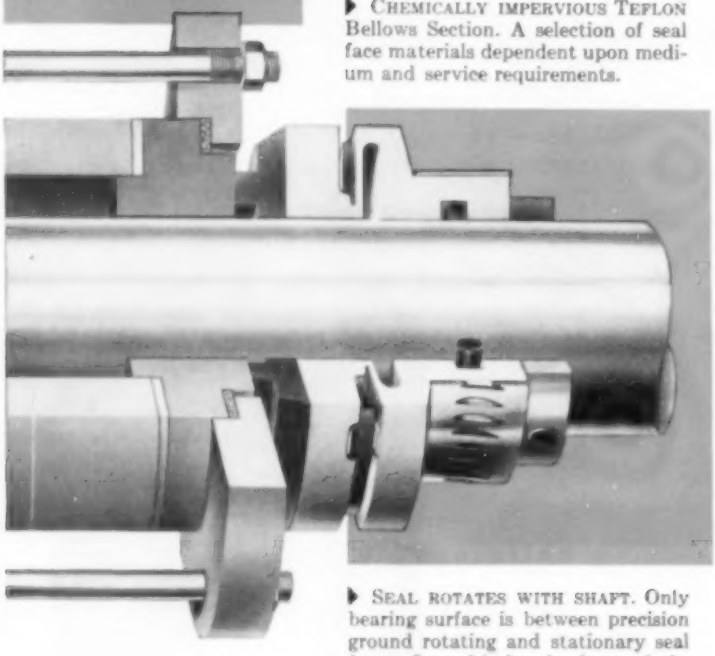
# Performing Seal!

**Service that no other Mechanical Seal can match**

Pump difficult chemicals...with drop-tight service over longer periods of time. That is what Chemiseal's chemically impervious TEFLON, pressure-balanced bellows design offers you.

The ideal Mechanical Seal that has no equal in handling acids, alkalies, solvents, hydrocarbons, alcohols--clear liquids, slurries and tarry materials.

**FEATURES**



- CHEMICALLY IMPERVIOUS TEFLON Bellows Section. A selection of seal face materials dependent upon medium and service requirements.
- SEAL ROTATES WITH SHAFT. Only bearing surface is between precision ground rotating and stationary seal faces. Low friction load on shaft. Lower power cost. Drop tight service.
- NO SCORING OF SHAFTS and Chemiseals work satisfactorily on shafts previously scored by other seals or packing.
- PRESSURES at the seal up to 100 psi at 75°C or 75 psi at 100°C.
- SIZES from ¾" to 2½". Other sizes for special applications.
- MAXIMUM LENGTH, all seals 2¾".

**made of du Pont TEFLON**

Write for Bulletin No. MS-954.

**UNITED STATES GASKET COMPANY,** CAMDEN 1, NEW JERSEY

**USG** FABRICATORS OF FLUOROCARBONS & OTHER PLASTICS

Representatives in principal cities throughout the world




dust: 12-page *Bulletin 4-R* contains technical details and typical applications such as removal of sulphur dioxide, handling of chlorine, fluorine, hydrogen sulphide, carbon disulphide, ammonia, carbon black, zinc oxide, and other noxious or objectionable materials. Schutte & Koerting Co., Dept. J-S, Cornwells Heights, Bucks Co., Pa.

*Circle No.* **52** *on Reply Card*

### Resin Coatings

. . . describing Vinyl, Phenolic, Saran, Polyethylene, Epon, Neoprene, Plastisol, and Silicone materials: Bulletin on *Synthetic Resin Coatings* shows applications to storage tanks in the shipping, petroleum, pickling, and chemical industries. Metalweld, Inc., Scotts Lane & Abbottsford Ave., Philadelphia 29, Pa.

*Circle No.* **53** *on Reply Card*

### Alloy Valves

. . . made of Monel and nickel: *Bulletin No. 9* discusses the corrosion-resistant properties of Monel and nickel, listing specific applications for which each is suited, and giving the casting composition of both alloys and their mechanical properties. Make request on company letterhead to Alloy Steel Products Co., W. Elizabeth Ave., Linden, N. J.

### Weld Properties

. . . for stainless steel deposits, associated with design of tubular products in steam superheaters, heater coils, and high temperature piping installations: *Technical Data Card 178* gives the chemical composition, room temperature hardness, and stress-rupture strength of more than 12 chromium nickel stainless steel weld deposits. Babcock & Wilcox, 161 E. 42nd St., New York, N. Y.

*Circle No.* **54** *on Reply Card*

### Sequencing Timing

. . . for use in water treatment, chemical and food processing plants, and other equipment: *Data Sheet No. 11.12-1* describes two systems for obtaining sequence timing control. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa.

*Circle No.* **55** *on Reply Card*

### Additive Injection

. . . for petroleum streams: Reprint from the March, 1955 issue of PETRO-

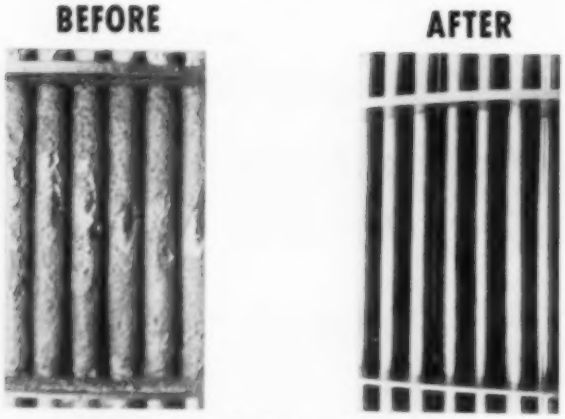
# GOING PLACES *in the roaring jets with Cities Service...*

The gargantuan, ever-growing thirst of the military jet planes was slaked last year by 124,000,000 gallons of Cities Service jet fuels. Cities Service refineries are geared to provide increasing quantities of vital defense matériel.

CITIES SERVICE

*A Growth Company*

*Number 13 of a series*




Heat Exchanger bundle before and after cleaning with recommended solvent and improved Oakite Compound 88

# How to Cut Equipment Outage through Faster, Easier Cleaning

Impressive cleaning results like those shown above are not unusual when modern Oakite methods are utilized. Whether you're cleaning heat exchangers, fractionating towers, or cat crackers, you'll find you can do a better, more thorough job when you depend on Oakite's cleaning know-how and materials. Here's why:

Oakite refinery cleaners are especially compounded to penetrate even the heaviest petroleum soils and grease residues. Their fast-acting detergency often reduces cleaning time by as much as 75%! This means that out-of-service time is cut sharply—maintenance costs are considerably lessened. Often, equipment that may have been destined for the scrap heap is again restored to operational efficiency. No matter how you look at it, switching to modern Oakite cleaning methods and materials means immediate savings—both in time and money.

Your local Oakite Representative will gladly tell you more about Oakite economy cleaning—call him today. And send for your FREE copy of valuable refinery cleaning guide. No obligation. Write Oakite Products, Inc., 50D Rector St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE

PETROLEUM SERVICE DIVISION

Technical Service Representatives in Principal Cities of U. S. and Canada



## Do You Need More Engineers?

Order your reprint today of this popular and helpful article from the May issue of PETROLEUM PROCESSING, telling how some oil companies are easing the shortage of engineers without increasing their staff.

| | |
|---|---|
| Single copies | 50¢ each |
| Up to 10 copies | 30¢ per copy |
| Up to 49 copies | 25¢ per copy |
| Up to 99 copies | 20¢ per copy |
| 100 or more copies | 15¢ per copy |

**Address: Readers Service Department**
**PETROLEUM PROCESSING**
**330 West 42nd Street, New York 36, N. Y.**

Note: New York City residents add 3% sales tax




LEUM PROCESSING, entitled "Five Methods for Injecting Petroleum Additives," discusses the use of constant flow injection, flow proportional injection, injection rate above 2 gpm., vacuum injection of dry additives, and gravimetric control of injection. Proportioneers, Inc., 345 Harris Ave., Providence, R. I.

*Circle No.* **56** *on Reply Card*

### Air Dryers

. . . for air-actuated tools, valves, instruments, etc.: *Bulletin D-101* gives complete descriptions, condensed specifications, and dewpoint and selection curves. C. M. Kemp Mfg. Co., 405 E. Oliver St., Baltimore 2, Md.

*Circle No.* **57** *on Reply Card*

## Did You Miss These?

*The following items, reviewed originally in July, have aroused considerable interest among the readers. They are repeated briefly as a service to those who might have missed them the first time they appeared. For details or literature, please use the regular Reply Card in this issue.*

### Controlling Viscometer

. . . **records continuously** for applications in the petroleum industry. The viscometer is applicable also for automatic control. A side stream is established to flow a small sample to the temperature-compensated measuring element for viscosity determination. A heat exchanger can be used when necessary to bring the temperature of the sample within the compensating range and a small proportioning pump is used to return the sample in the line. All of the electrical components comply with Underwriters' requirements for Class I Group D locations. A remotely located recorder furnishes a record on a 24-hour circular chart, and for automatic control the recorder provides 3-15 lbs. air pressure for use in conjunction with standard pneumatic controllers. The operating principle provides high sensitivity and accuracy with ruggedness of construction. Norcross Corp., Dept. No. N33, Newton 58, Mass.

*Circle No.* **58** *on Reply Card*

### Multi-Component Analyzer

. . . **is for gases or liquids** and is based on the principle of gas chromatography, utilizing the fractional separation of vapors by means of a partition

# Fittings stay fastened in Corrosive Acid Spray

**PROBLEM:**

Selecting fastenings that would hold pipe fittings together in a unit that is constantly subjected to a hot sulphuric acid spray. Bolts were formerly falling apart in four months' time.

**REMEDY:**

Use of nuts and bolts made of wrought HASTELLOY alloy C.

**RESULT:**

Fastenings made of HASTELLOY alloy C are still holding many months after ordinary bolts had to be replaced.

HASTELLOY alloy C is the most universally corrosion-resistant alloy available today. In addition to aerated sulphuric acid, it has excellent resistance to such strong oxidizers as nitric acid, wet and dry chlorine, and acid solutions of salts. It is available in nearly all standard commercial forms.

For more information on HASTELLOY alloy C, get in touch with the nearest Haynes Stellite Company Office.

HAYNES TRADE-MARK ALLOYS

**HAYNES STELLITE COMPANY**

**A Division of Union Carbide and Carbon Corporation**

UCC

General Offices and Works, Kokomo, Indiana

Sales Offices

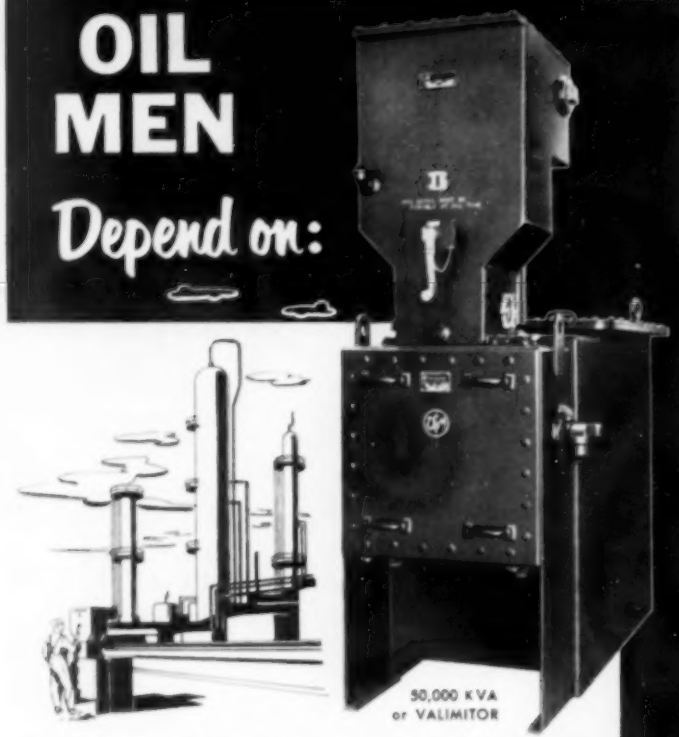
Chicago • Cleveland • Detroit • Houston • Los Angeles • New York • San Francisco • Tulsa

*"Haynes" and "Hastelloy" are registered trade-marks of Union Carbide and Carbon Corporation*



*(To obtain more data on advertised products see page 1628)*

# OIL MEN Depend on:




## EC&M 2200-5000 VOLT Motor Starters

These EC&M Division 1 combination Starters for Class I, Group D hazardous locations give petroleum men top-value. They require less floor space . . . line, motor and control leads are brought to conduit connection box for quick installation . . . and interrupting capacity is high . . . either 50,000KVA or in the VALIMITOR (volt-ampere-limitor) type, unlimited short circuit protection.

Oil disconnect switch (on top) may be locked open or closed, and has view windows on both sides to show switch contacts. Overload Relays of THERMAL-MAGNETIC type (mounted in conduit connection box) give accurate motor protection . . . trip instantly on faults.

Rear oil-tank has potential transformer for 220-volt push button circuit. 50,000 KVA type ZHS Magnetic Contactor may be inspected without disconnecting any bolts or leads. Contacts are copper tungsten alloy. VALIMITOR Starters, with air-core current-limiting reactors in rear tank, limit fault current to 25,000 KVA . . . ZHS Contactor clears circuit quickly. No fuses, no need to figure short possibilities . . . supply bus can be infinite KVA.

Before buying, investigate EC&M Combination Starters . . . they provide economy in installation, operation and maintenance . . . and they're complete in every respect.

*Write for 16-page Booklet 1062 on EC&M 2200-5000 volt starters.*

THE ELECTRIC CONTROLLER & MFG. CO.
4498 LEE ROAD, CLEVELAND 28, OHIO




column. Time for analysis varies from ½ to 5 minutes per component. Reproducibility is better than ½%. Any mixture having boiling points up to 250°C. may be analyzed. As little as one milligram of sample per analysis is needed. The "Vapor Fractometer" consists of two interchangeable four-foot folded partition columns which may be used individually or in tandem, a special thermister-type thermoconductivity cell as a detector, and sampling and temperature controls. The partition columns are mounted in an insulated chamber which may be held at any temperature between room and 150°C. The apparatus weighs less than 50 lb. and measures 30 x 20 x 12 in. Detector output may be connected directly to any standard 10 millivolt recorder. Any convenient carrier gas may be used, though helium is recommended. The Perkin-Elmer Corp., Norwalk, Conn.

*Circle No.* **59** *on Reply Card*

### Synthetic Ammonia

. . . using one of four different basic plant types to generate synthesis gas, tailored to suit local conditions and feed materials: 12-page booklet *Synthetic Ammonia* details purification methods and use of steam reforming, catalytic partial oxidation, non-catalytic partial oxidation and low-temperature raw gas conversion with flow diagrams; includes two case histories with investment and operating costs. The M. W. Kellogg Co., 225 Bdwy., New York 7, N. Y.

*Circle No.* **60** *on Reply Card*

### Glycols and Triols

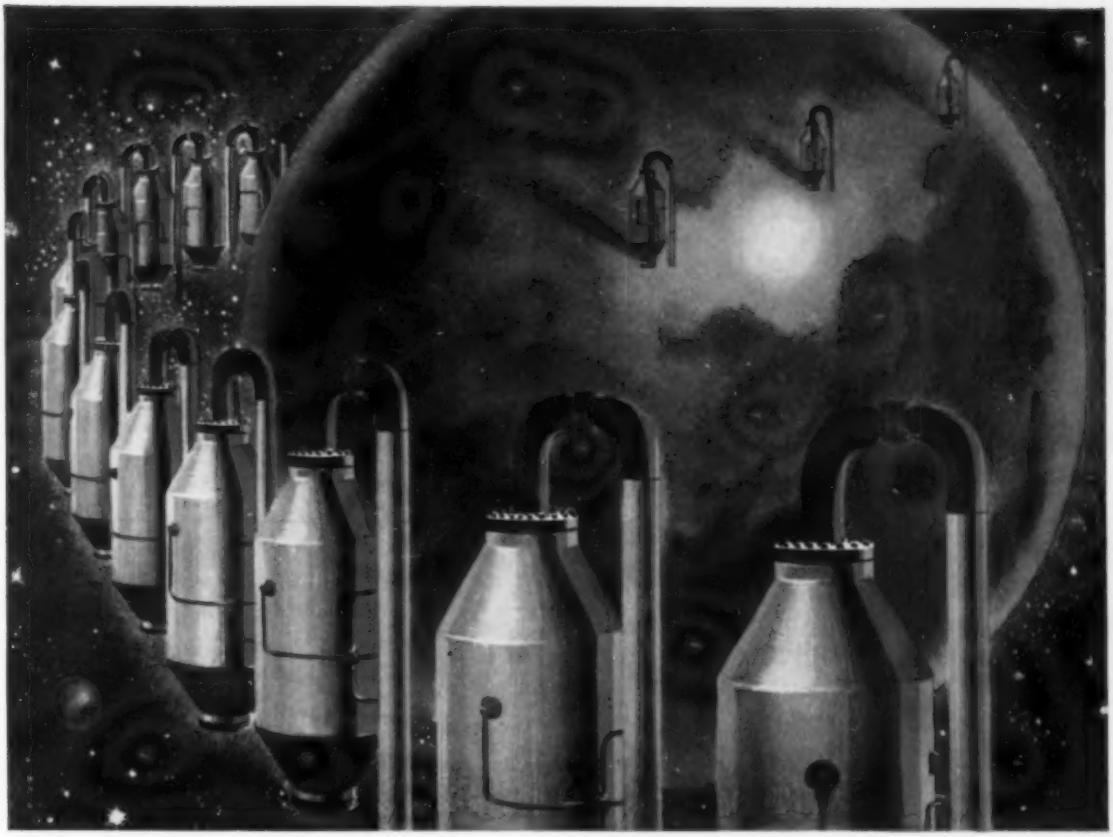
. . . available in commercial or development quantities: 60-page *"Glycols" (F-4763)* describes uses and suggested applications for glycols and gives properties, shipping information, specifications, test methods, and constant-boiling mixtures. Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.

*Circle No.* **61** *on Reply Card*

### Vapor Pressure Charts

. . . for use as standards for specification and control purposes in the production, refining, and sales branches of the industry: 20-page booklet, *Vapor Pressure Charts for Petroleum Hydrocarbons* has been approved for distribution by the API Committee on Petroleum Products. The American Petroleum Institute, 50 W. 50th St., New York 20, N. Y.

*Circle No.* **62** *on Reply Card*



*Now...Thanks to Catforming...*

## HIGH OCTANES, HIGH YIELDS AT LOW COST!

Today, well into its third year of commercial operation, Atlantic's Catalytic Reforming Process is proving its ability to give superior results on a broad variety of feed stocks.

Catforming's simplicity brings savings through increased efficiency every step of the way—actually cutting out many intermediate steps.

Regardless of the size of your operation or the nature of your charge stock, Catforming merits your attention. One reason Catforming has "proved out" commercially is Atlantic's broad experience in all phases of petroleum refining.

Phone or write for our detailed brochure, "CATFORMING." The Atlantic Refining Company, Research and Development Dept., P. O. Box 8138, Philadelphia 1, Pa.

*it's the CATALYST that counts*

**ATLANTIC**

# What's the Best Temperature

## Reformer Reactors, Cat for Column Reboilers and

WHY is it the best for these critical gas-fired furnace temperature applications? Because *both* the TRANSAIRE Transmitter and the TRI-ACT Controller respond practically instantaneously and with the right amount of correction to control the slightest temperature variation. Result—*truly uniform furnace outlet temperatures*. In fact, field experience has proven that there is no better control system on the market at any price for these applications. Here's why:

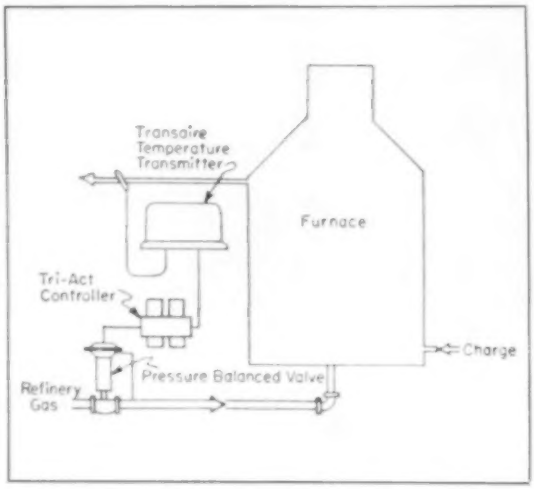
**1.** Extreme sensitivity in the transmitter (1/10 of 1%) signals the minutest of process changes to the controller.

**2.** SPEED-ACT* (rate action) permits the signal from the transmitter to follow accurately the dynamic changes in process, overcoming inherent process and well lags.

**3.** The sensitivity of the TRI-ACT controller (1/10 of 1%) provides instantaneous corrective valve action.

**4.** The TRI-ACT circuit (PRE-ACT*—rate action—ahead of reset and proportional) permits higher PRE-ACT settings which produce corrective valve action of just the right magnitude for straight line control.

The TRI-ACT controller is the *only* pneumatic controller that has such an advanced circuit.




The TRANSAIRE Transmitter, with its short range spans of 100, 200 or 400°F. is particularly adaptable to these high temperature applications. In fact, it provides the same quality of control on cat crackers with temperatures up to 1200°F.

*Trade Mark

# The Taylor TRANSAIRE® Temperature

## the TRI-ACT® Controller . . . and it

# **Control System for...** Feed Preheaters to Crackers and Crude Units, and Furnaces Hot Oil Circulating Systems?

**BENEFITS TO YOU**

**1.** You are able to maintain constant optimum temperatures on feeds to cat crackers, reformers, reactors, etc.

**2.** You obtain higher yields of specification product.

**3.** Your operating costs are substantially reduced.

**4.** The on-stream life of your furnace is considerably extended because the TRI-ACT controller reduces coking which usually results from variations in load or fuel supply.

Call your Taylor Field Engineer for more detailed information about this highly successful system, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

*Taylor* TRANSAIRE *Temperature Transmitters in use on Reformer Reactor Pre-Heaters at a well known South Western gasoline plant.*

**Taylor Instruments MEAN ACCURACY FIRST**

**Transmitter,** coupled with costs the LEAST!

# EDITORIALS . . .

## On that Fire at Standard of Indiana

A MONTH ago the Whiting refinery of Standard Oil Co. (Ind.) experienced a most disastrous explosion and fire. There have been many more serious fires in terms of lost lives; this one took only two. But few have wrought as much damage.

Our story of what happened at Whiting as far as we have been able to put it together from various sources appears in this issue—pg. 1559.

We spent some time at Whiting after the fire, and we have talked to a number of people outside the company about the fire. As a result of our observations and conversations we have a few editorial opinions on the event:

**We Commend**

Indiana Standard deserves every possible praise for the way in which it handled this fire. The company's fire fighting performance showed the value of organization and training. Throughout the plant the men knew what to do and did it.

From a public and community relations angle, the company also performed exceptionally well. No iron curtain was thrown up around the plant, no effort was made to withhold information of interest to the public.

Shortly after the start of the fire the company announced that it recognized its responsibility to the community, and was at once setting up an office to receive and settle claims for damages caused by the explosion and fire. These included, among other things, structural damage to property, glass breakage, food spoilage (when electricity was cut off), and temporary housing (when an area adjacent to the plant was evacuated). Where feasible, claims have been settled on the spot, with the claimant's word being taken for the amount of his loss.

These activities reflect to the credit of Indiana Standard. People in the Whiting area have increased respect for the company as a result of its positive actions.

**We Criticize**

We don't think, however, that the company is totally without criticism for the event which took place.

We are not referring to the Orthoformer explosion. On that point, not enough information is available to indicate what caused it and whether or not it could have been prevented.

However, the rapid spread and extent of the fire which resulted, in our own personal opinion, could have been minimized to some extent. A look at some of the published aerial photographs of the burned out tank area show them to be far too close for safety.

We make this criticism with some reservations. The Whiting refinery has been there a long time and over the years has grown; we realize that it is not always practical or even possible to keep an older plant as modern as is desired. There might have been circumstances at Whiting with which we are not familiar and which prevented the company from doing anything about that tank farm.

**We Suggest**

As is to be expected, Standard of Indiana is conducting an intensive investigation into what caused the failure of its Orthoformer—and with the research and engineering facilities at its disposal that investigation should certainly be a thorough one. When it is complete and the full story of what happened is known, we suggest the company not sit on its findings.

A failure such as experienced at Whiting naturally raises a lot of questions—not only in the minds of people who are operating catalytic reformers, but particularly in the minds of those who have to deal with them from a non-technical viewpoint.

Insurance firms may be concerned over what their liability is likely to be on the many catalytic reformers they have insured. They want to know what risks are involved, what might happen in the way of malfunctioning of a unit, and what precautions should be employed by plant operators to afford reasonable protection. If they fail to receive satisfactory answers they are likely to assume the worst and adjust their premiums accordingly.

Refiners in built-up areas—residential or industrial—can expect to have some questions asked about the safety of their reformers. There may be some doubts about the issuance of building permits for new units.

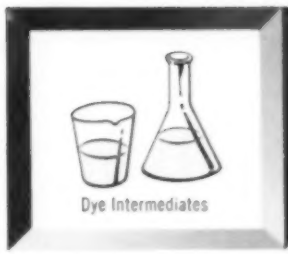
We do not raise these questions with any thought of suggesting that they are valid from a technical viewpoint. We think they are questions that could be raised by people outside the industry, who can't be expected to be familiar with the various types of reformers.

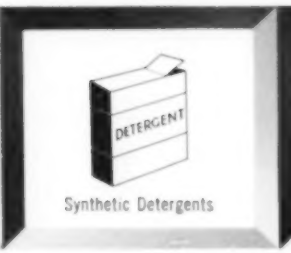
When the full story of what happened to the Whiting Orthoformer is known, we sincerely hope Standard of Indiana will recognize its responsibility to the industry and makes the facts freely available. We think the industry is entitled to know what caused the unit to fail.

# FOR SULFONATIONS SULFATIONS

# Use SULFAN®

(Stabilized Sulfuric Anhydride)



# . . . Here's Why!

**You Improve Sulfonation Efficiency.** SULFAN has 99.5% $SO_3$ available for sulfonation reactions. In many applications, this means considerable savings in operating costs because SULFAN offers nine times as much usable $SO_3$ as 100% sulfuric acid, and over three times as much as 20% oleum.

**You Increase Batch Sizes.** With SULFAN, there is no waste acid. This means larger batch sizes (or more rapid through-put) . . . often double without increasing size of equipment! Since no water is formed when SULFAN is used for sulfonation, the waste acid problem inherent with sulfuric acid or oleum is also eliminated.

**Benefits of operating efficiency,** ease of handling and waste acid elimination make SULFAN worth your prompt investigation. Write today for technical information. A letter outlining your specific needs will enable us to supply data of value to you. As always, information regarding your process will be held in strict confidence.

*Product Development Department*

**GENERAL CHEMICAL DIVISION**

ALLIED CHEMICAL & DYE CORPORATION

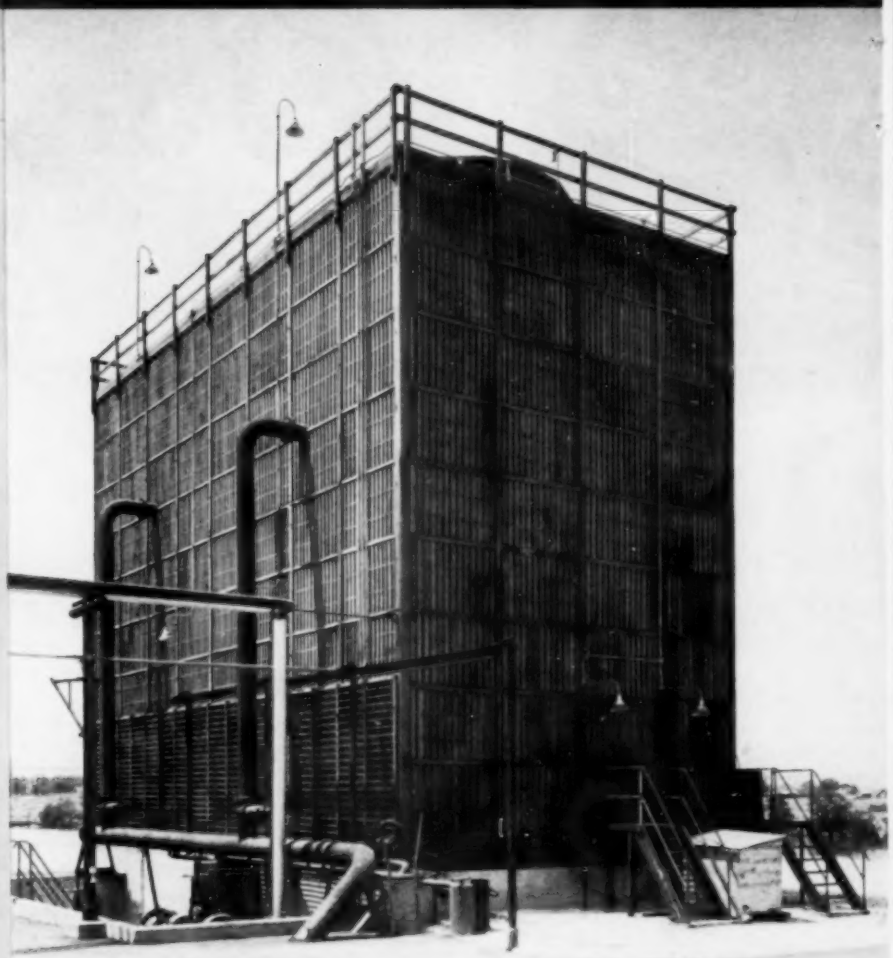
**40 Rector Street, New York 6, N. Y.**

GC Allied Chemical

*Basic Chemicals for American Industry*

# Completed in 59 Hours!

*To meet an emergency need, this two-cell Santa Fe cooling tower was erected in the record time of 59 hours.*



**With Santa Fe's exclusive prefabricated design, time required in the field to erect a cooling tower is substantially reduced, with corresponding lowering of installation costs.**

**SANTA FE**
TANK & TOWER CO., INC.
5401 South Boyle Avenue • Los Angeles 58, California
Branch offices in all principal cities

"Our best ads are installed."